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CANADIAN GEOGRAPHICAL JOURNAL

VOL. XXXIX • No. 3 • SEPTEMBER 1949 • PRICE 35c

W. V. CRICH

Stooks gilded by the setting sun cast long shadows across the fruitful earth.

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As one of its major activities in carrying out its purpose, the Society publishes a monthly magazine, the Canadian Geographical Journal, which is devoted to every phase of geography—historical, physical and economic—of Canada, of the British Commonwealth and of the other parts of the world in which Canada has special interest. It is the intention to publish articles in this magazine that will be popular in character, easily read, well illustrated and educational to the young, as well as informative to the adult.

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CANADIAN GEOGRAPHICAL JOURNAL

Published monthly by
THE CANADIAN GEOGRAPHICAL SOCIETY
36 Elgin Street, Ottawa

Editor - GORDON M. DALLYN — Assistant Editor - MALVINA BOLUS

This magazine is dedicated to the interpretation, in authentic and popular form, with extensive illustrations, of geography in its widest sense, first of Canada, then of the rest of the British Commonwealth and other parts of the world in which Canada has special interest.

The articles in this Journal are indexed in the *Canadian Periodical Index* which may be found in any public library.

The British standard of spelling is adopted substantially as used by the Dominion Government and taught in most Canadian schools, the precise authority being the Oxford Dictionary as edited in 1936.

Address all communications regarding change of address, non-delivery of Journal, etc., to the publication office, 1,000 St. Antoine St., Montreal, Canada, giving old and new address. On all new memberships, the expiry date will be printed on wrapper containing starting number. This will constitute a receipt for subscription.

Membership dues of The Canadian Geographical Society, which include postpaid delivery of the Journal, are $4.00 per year in any country, payable at par in Ottawa.

Member Audit Bureau of Circulations

SPECIAL REPRESENTATIVES:

Ontario and Quebec: F. A. DALLYN

Toronto office — 21 King Street, E. (Tel. EL. 2863)

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Photograph by W. V. Crich

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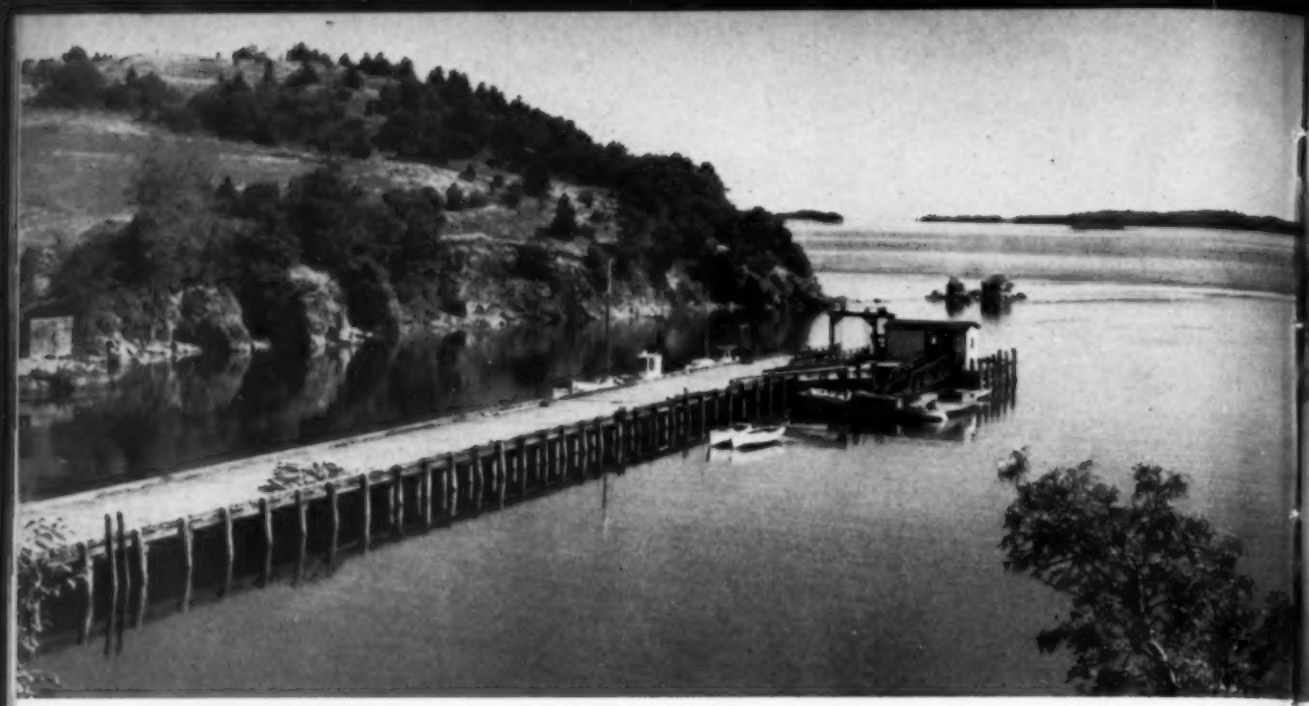


The Isles of Fundy

by F. J. ALCOCK

THE BAY OF FUNDY with its inlets and headlands, its cliffs and beaches, its rocks of many varieties and hues, its immense tides, its boats and weirs and picturesque fishing scenes is a region which everyone who loves the sea finds most satisfying. If in addition the sea lover is even an amateur student of geology or geography he will be further attracted by the long and varied story that the sedimentary strata and the igneous masses have to tell of erosion and deposition, of volcanic activity and mountain-building, of uplift and subsidence, of the advance and retreat of glaciers and of the continued attack on the land made by wave and tide. Perhaps the most interesting part of all this area includes what are known as the Isles of Fundy near the Maine border. There are three main islands—Deer, Campobello and Grand Manan—and many smaller ones ranging down to mere points of rock. Off the beaten track for tourists, their charm is, nevertheless, known to many enthusiastic visitors, quite a number of whom have formed the habit of returning; some do so year after year and not a few have built themselves summer homes on the islands.

Deer Island

Deer, with a number of smaller islands, separates the Bay of Fundy proper from Passamaquoddy Bay into which the St. Croix river empties. It is readily reached by leaving the main highway at the town of St. George, taking the road to L'Etête, and from there a ferry which accommodates cars and trucks as well as passengers. This last three-mile stretch by water, particularly on a bright day when the tide is swirling through the channels between the islands, is a very attractive ride.

Arrived on the island, one is impressed by the pleasant homes and the number of settlements of which Lords Cove and Fairhaven are the largest. A road leads around the island from which any part can readily be reached. Besides the ferry service a mail boat makes a daily round trip leaving Lords Cove in the morning calling at other ports on the island and also at Campobello, St. Andrews, and Eastport.

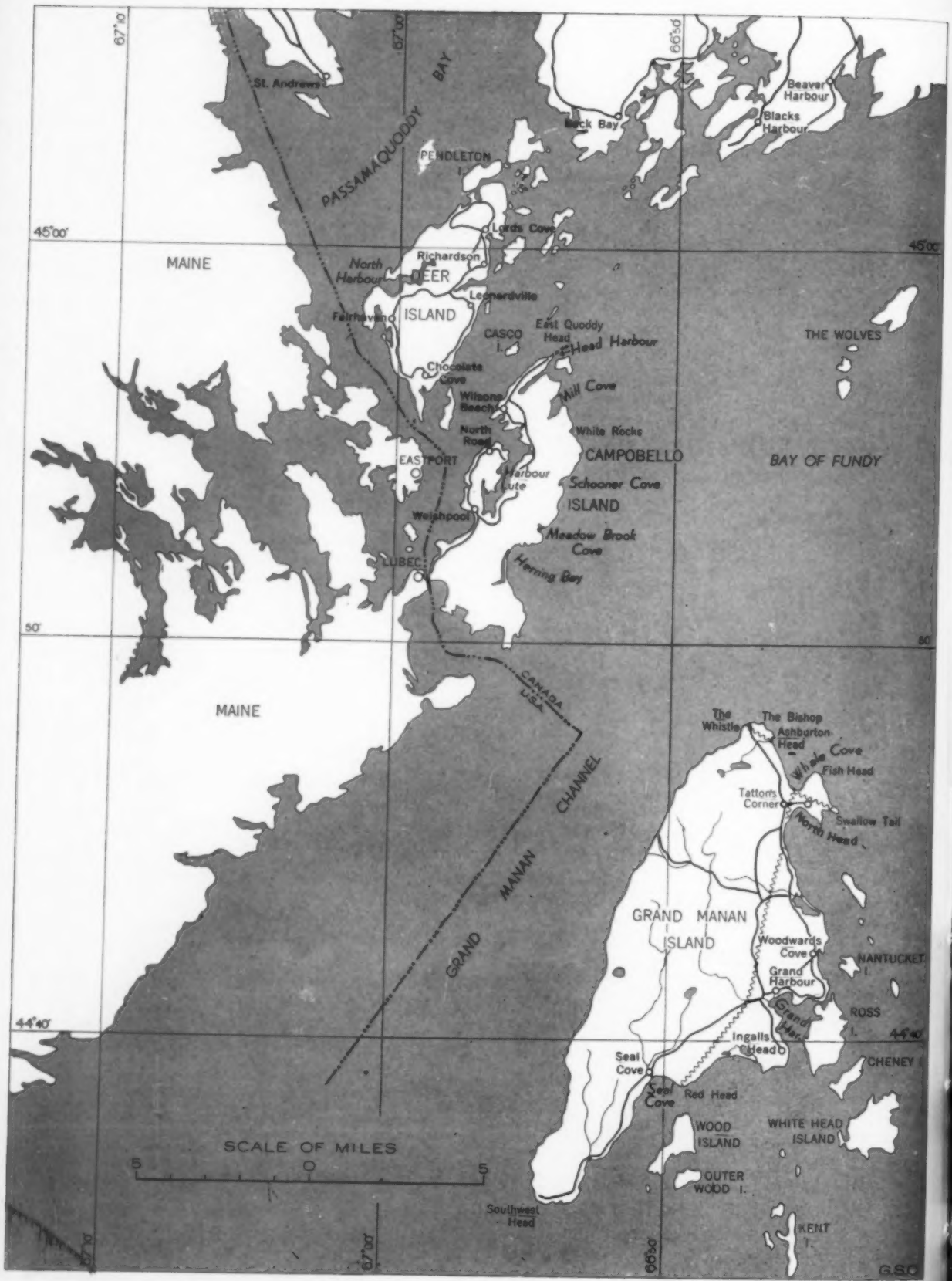
Photographs by the New Brunswick Government Information Bureau and the author

F. J. Alcock

Above:—The channel between Deer and Pendleton Islands

Top left:—Chocolate Cove, one of Deer Island's little fishing harbours

Below:—Mallock Beach, North Road, on Campobello Island



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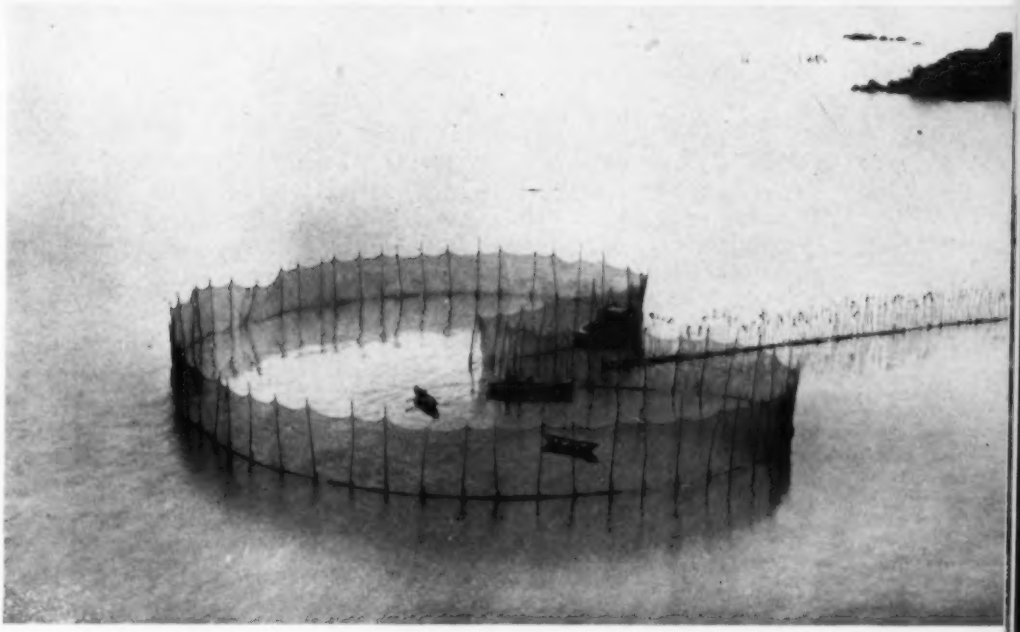


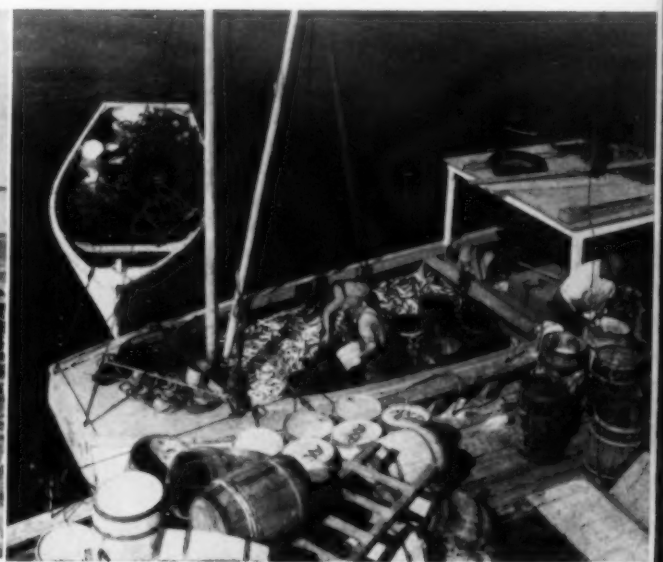
Weirs such as this are used by Fundy fishermen to trap herring. Here the herring are being seined.

Coastal fishing is the main source of livelihood on the Fundy Isles, although residents also carry on small farming operations.

Right centre:—Loading herring from the seine into the boat

Right bottom:—Unloading herring from the fishing boat

Below:—A lobster pound at Priest Cove on Grand Manan



Wilsons Beach on Campobello Island

The principal industry is trapping sardine herring by means of weirs. A visit to the lobster pound on North Harbour, where thousands of lobsters are fed until they reach a desirable size for shipment, affords a picture of another industry.

A word as to fishing by means of weirs may be helpful since it concerns all three of the islands mentioned and much of the Fundy mainland. The weir is an enclosure, circular in outline, connected to the shore by a straight part known as the "leader"; it is constructed of piling, brushwood, and netting. The schools of young herring, following the feed brought along by tidal currents, are guided by the "leader" through a narrow opening into the trap and projecting partitions prevent their escape. The largest catches are usually made during the night.

Seining the weir is an operation of interest for the visitor to watch. A seine (net with floats at top and weights at bottom edge) is run around on the inside of the weir and is then drawn together until the fish are closely massed so that they can be bailed out into small boats from which they are transferred to the sardine boat for transportation to the canning factory. When the boats are emptied the silvery scales that remain are carefully collected for they are in demand for the manufacture of ornamental material for toilet articles, imitation jewellery, and other things.

F. J. Alcock

Welshpool, August 1, 1946, when a memorial to F. D. Roosevelt was unveiled.

Deer Island has almost continuous rocky shores composed of interbedded volcanic and sedimentary rocks of Silurian age intruded by dikes and masses of diabase. On two islands to the east, Adams and Simpson, occurrences of copper minerals, bornite and chalcopyrite, are known, and development work has been carried out on more than one occasion in the hope of finding workable deposits.

Campobello

Though Campobello lies only a couple of miles from Deer there is a considerable difference between the islands. Connected with the New Brunswick mainland by ferry Deer may be said to face northeast towards the rest of the province. Campobello, though equally Canadian, faces towards Maine. "Going to town" means crossing to Eastport in the United States. The narrow stretch of water between the two islands is a real barrier in spite of all the boats on both and a person on Deer desiring to take his car to Campobello must make the circuit of Passamaquoddy Bay, a distance of some sixty miles, and cross by ferry from Lubec.

Welshpool on the west side of the island is the main centre for the southern and western parts of the island which contain most of the summer homes. Wilsons Beach to the north is the main fishing centre. The exposed eastern coast is for the most part one of bold rock cliffs broken here and there by coves. The largest of the latter is attractive Herring Bay or Cove with a gravel bar a mile in length, either end of which can readily be reached by motor car. Other interesting drives or walks are from Welshpool to North Road and from Wilsons Beach to East Quoddy Head. On this point there is a lighthouse which at low tide can be reached on foot but which at high tide is separated from Campobello proper by a channel through which boats can pass.

Like Deer Island most of the year-round inhabitants are connected in some way with the fishing industry. There are a considerable number of sardine weirs but the majority of the fishermen are engaged in coastal hand line fishing. The common type of boat employed for this purpose is one about forty feet long, half decked, and powered by a secondhand automobile engine.

History

The island appears on Champlain's map dated 1612 and it is known that in the latter part of that century French settlers were located at Harbor de Lute. In 1704, however, a force from Massachusetts under the command of a Colonel Church so effectively ravaged the region in reprisal for attacks on that state by French and Indians that the French settlers left never to return and for the next sixty or so years there appears to be no mention of the island. In 1763 the region around Passamaquoddy Bay, however, began to attract settlers and in 1766 Robert Wilson settled at what became known as Wilsons Beach. He was soon followed by two other families.

About this time the British Government was making grants of land to officers of the British Army and Navy and in 1767 Campobello was given to Captain William Owen of

F. J. Alcock

Herring Cove beach, Campobello, near Dinner Point

F J. Alcock

the Royal Navy and three of his relatives. Owen belonged to an old Welsh family. He had been present at the capture of Pondicherry from the French in 1760, an engagement in which he lost his right arm, and took part also a second time in the taking of that town.

In April 1770 Captain Owen came out to his island on a ship named the *Owen*, bringing with him thirty-eight colonists of varied trades. He selected a site at Curry's Cove, or Harbour Port Owen as he called it, near Wilsons Beach, for building a town. The three families already there at once recognized his ownership rights. It is interesting to note that Captain Owen at this time gave the island its name. Previously known as Passamaquoddy Island it now became Campobello, in part, as Owen states, complimentary and punning on the name of the Governor of the Province of Nova Scotia which at that time included New Brunswick, Lord William Campbell, by whom the grant had been made, and partly as applicable to the nature of the soil and fine appearance of the island. Captain Owen left the island in 1771 and seven years later he lost his life by an accident at Madras.

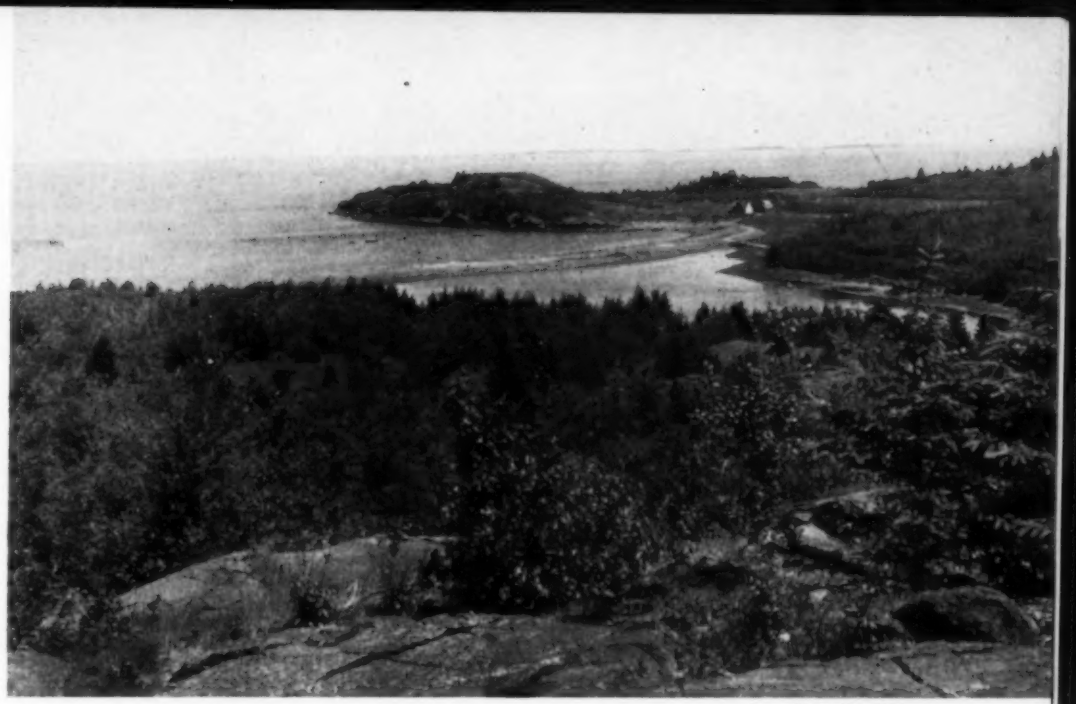
Captain Owen had two sons both of whom followed their father's profession. The elder, born on Campobello, February 19, 1771, became Vice-Admiral Sir Edward William Campbell Rich Owen, K.C.B., G.C.H. The second son rose to be Vice-Admiral William Fitzwilliam Owen particularly noted for his surveys of coasts in various parts of the world. He lived from 1835 until 1839 on Campobello on a lovely site at Welshpool facing the Maine coast. He later moved to Saint John where he died in 1857. His remains are buried in the churchyard at Welshpool.

Scenes on Campobello Island

Top:—Head Harbour

Centre:—Rhyolite and diabase, Schooner Cove, on the east coast

Bottom:—Archway cut in Silurian argillites on the west coast.



Mill Cove, Campobello, with The Wolves in the distance

F. J. Alcock

Residents of Ontario will be interested in the fact that on October 1, 1948, there was unveiled on the grounds of the Public Library at Owen Sound a monument erected by the National Parks Service, on the recommendation of the Historic Sites and Monuments Board of Canada, bearing the following inscription:

> In 1814-16 the first Admiralty Survey of Lake Ontario and Georgian Bay was undertaken by Admiral William Fitzwilliam Owen, after whom Owen Sound is named. His successor, Admiral Henry Wolsey Bayfield, completed the first survey of Lakes Erie, Huron, and Superior in 1817-25. The work of these officers rendered great service to Canada by increasing the safety of Navigation.

Another member of the Owen family, David Owen, a nephew of Captain William Owen and one of the original grantees, came to the island in 1787 and lived there for some forty years. One by one, however, the various members of the family left the island and in 1881 it was purchased from the Owen heirs by the Campobello Land Company. A building "The Owen" was erected on the site of Admiral Owen's private domain at Welshpool.

In 1884 James Roosevelt of New York built a summer home on the Island, about a mile southwest of Welshpool, and for many years as a boy and later as a man his son, Franklin Delano Roosevelt, found recreation there. In recognition of this fact there was unveiled on August 1, 1946, a memorial to him in front of the library at Welshpool. The plaque is on a cairn nine feet high composed of seventy-two blocks of reddish granite quarried near St. George. The occasion of the unveiling was a memorable one. An American destroyer brought representatives of the United States and a Canadian destroyer, the *Micmac*, a large Canadian party. The chairman for the ceremonies was Dr. J. C. Webster, C.M.G., the noted New Brunswick historian, and the monument was unveiled by the Honourable D. L. MacLaren, Lieutenant Governor of the province. Addresses were given by the Honourable J. Allison Glen, Minister of Mines and Resources in the Dominion Government representing Prime Minister Mackenzie King, by the Honourable J. P. McNair, Premier of New Brunswick, by J. T. Calder, President of the Campobello Board of Trade, by Mrs. Eleanor Roosevelt and by the Honourable Ray Atherton, United States Ambassador to Canada.

The memorial reads:

IN HAPPY MEMORY
OF
FRANKLIN DELANO
ROOSEVELT
1882-1945

Statesman and Humanitarian who, during many years of his eventful life, found in this tranquil island, rest, refreshment, and freedom from care. To him it was always the "Beloved Island".

A.D. 1946

The Rocks

Like Deer, Campobello is composed of interbedded sedimentary and volcanic rocks of Silurian age cut by intrusives of probably similar age. Structurally the island falls into two parts. The northern two-thirds has northeast trends while the southern part shows northwest structures. Between the two is a sand plain country with few or no outcrops. Some of the bays like Head Harbour follow the strike of the rocks and have been eroded out of the softer sediments. The sediments are quartzitic argillites, slates and shales. The volcanic rocks vary from light-coloured acid types to dark basic varieties. White rocks on the east coast are composed of rhyolite. Dark coarse-grained diabase types are abundant in the south part of the island and at North Road.

Between Campobello and Deer are a number of small islands, White Horse, Spruce, Casco, Cherry, etc., which are composed of coarse, reddish conglomerate belonging to the Perry formation of Upper Devonian age. These lie along a major fault zone in which the Devonian beds have been dropped down alongside the Silurian rocks. The fault plane crosses Casco Island.

The Wolves

Some ten miles to the northeast of Campobello is a group of five small islands known as The Wolves. A few fishermen sometimes visit the islands and even make them a temporary stopping place for their fishing and lobster trapping operations, and there is a lighthouse on South Wolf. Otherwise they are uninhabited. The shores are mostly rocky with cliffs up to 100 feet high composed of reddish Precambrian granite but there are also a number of attractive sand and gravel beaches.

The writer had the rather unique experience of being wrecked on East Wolf on a bright clear day and with the sea perfectly calm. While circling the island to observe any variation in the character of the rocks the fisherman's boat from which the work was being done, the *Joan Helene*, ran on a submerged rock and as the tide was falling it was not possible to get it free before a large hole had been stove in the hull. A rescue was effected by a boat which had been seen anchored on the opposite side of the island. Aside from a night spent on the island and considerable anxiety until help arrived as to whether the boat was going to be a total loss no particular inconvenience was caused, and within a week the *Joan Helene* was again engaged in her fishing operations.

Grand Manan

If Campobello is different from Deer Island, Grand Manan can be said to be equally different from both of these and to have its own peculiar charm. Larger and farther out to sea, it is proud of its history and traditions, has an air of self-sufficiency, and though visitors are made welcome they are not sought-after. Beautiful drives, attractive trails for trips on foot, bold cliffs, inviting beaches, and a great variety of shore scenes offer a series of attractions to those who appreciate the restfulness of a holiday away from the stress of city life. The island is reached by boat from Saint John or St. Andrews. The stretch of open water from the nearest point on Campobello is only six and a half miles wide and from the east coast of the latter and from the Maine shore the high west side of the island is a marked feature. As one approaches it by boat the layered rocks in the cliffs known as the Seven Days Work can be seen; the course follows close to the volcanic masses of Fish Head and when opposite the Swallow Tail light there comes the deep sound of the heavy bell struck by the lighthouse keeper.

F. J. Alcock

The Joan Helene *at Pauls Cove on the west side of East Wolf. She was beached at high tide, her hull patched, and floated off at next high tide to be towed to Head Harbour.*

The ship rounds the headland and draws up at North Head pier in Flagg Cove.

History

The island of Grand Manan with its imposing cliffs must have been seen by all the early explorers of the region and was doubtless visited by some of them. Champlain writes of having anchored near Southern Head during a stormy night in 1606 and it is believed that a fourteen-foot anchor found there in 1842 was one lost by his ship on that occasion. The first survey of the island was made in 1734 by George Mitchell, deputy surveyor of Crown lands in Nova Scotia. In August 1770 Captain William Owen explored its shores. Indians frequently visited the island but the first white settlers were Joel Bonny, Abiel Sprague, and James Sprague who with their families arrived from Machias, Maine, in 1779. Alexander Bonny, one of Joel's children, was the first white child born on the Island. In 1783, following the close of the American Revolutionary War, a number of Loyalist families came to establish homes. Of these the two most important persons who stayed were Moses Gerrish and Thomas Ross. The former was a very able man, a graduate of Harvard, and a leading spirit in the settlement of the Island. He is buried on a lonely spot on Ross Island at a site selected by himself several years prior to his death. Other settlers were the Cheneys, Daggetts, Guptills, Wormells, Ingersolls, Bancrofts, Woosters, Ingalls, Newtons, and John and Joseph Blanchard, the last two of whom settled at Seal Cove. Kent Island was first occupied by Captain John Kent and Wood Island by a settler named Gerrald.

The question of who had the best rights to the sovereignty of the island was for a considerable time a matter of dispute but in 1817 the United States fully recognized the British claims. Two years later Great Britain decided to fortify it and Colonel Lord and two other officers were sent to select a suitable site. They decided upon Swallow Tail near North Head but the fort was never built.

Wharves at North Head on Grand Manan. Each year millions of pounds of fish are unloaded from boats such as those in the photograph.

Physical Features

Grand Manan has a length in a northeast direction of a little over fifteen miles and a greatest width of between six and seven miles, not including Ross Island which at low tide is part of the main island but which at high water is separated by a channel known as the Thoroughfare. To the east lie a number of islands. White Head, so called from the peninsula on its west coast composed of snowy white quartzite rock, has a considerable population. It is separated from Cheney Island by Cow Passage and the latter island in turn from Ross Island by Cheney Passage both of which at times of low tide are too shallow for even small fishing boats to pass through. There is a life-saving station on Outer Wood Island and on Kent Island a biological station maintained by Bowdoin College.

Grand Manan itself is composed of two parts. The eastern side underlain by ancient sedimentary and volcanic rocks is the settled portion. Most of the people are in some way connected with the fishing industry but a certain amount of farming is also carried out. The western two-thirds is composed of volcanic rocks of Triassic age. Where they outcrop on the coast they form dark forbidding cliffs which on the west side of the island in places reach heights of 400 feet. On the east side of the belt these volcanic rocks rise abruptly above the older softer sediments with which they lie in fault contact. A certain amount of farming is carried out along the eastern fringe of the belt but for the most part it is uninhabited.

Places of Interest

The visitor to Grand Manan may be content merely to relax at some pleasant site where he can enjoy the beauty of his surroundings and the varying moods of the sea. Or he may, on the other hand, wish to see as much as possible; in this case a trip in a fisherman's boat around the island is highly recommended, and roads and foot trails are most useful.

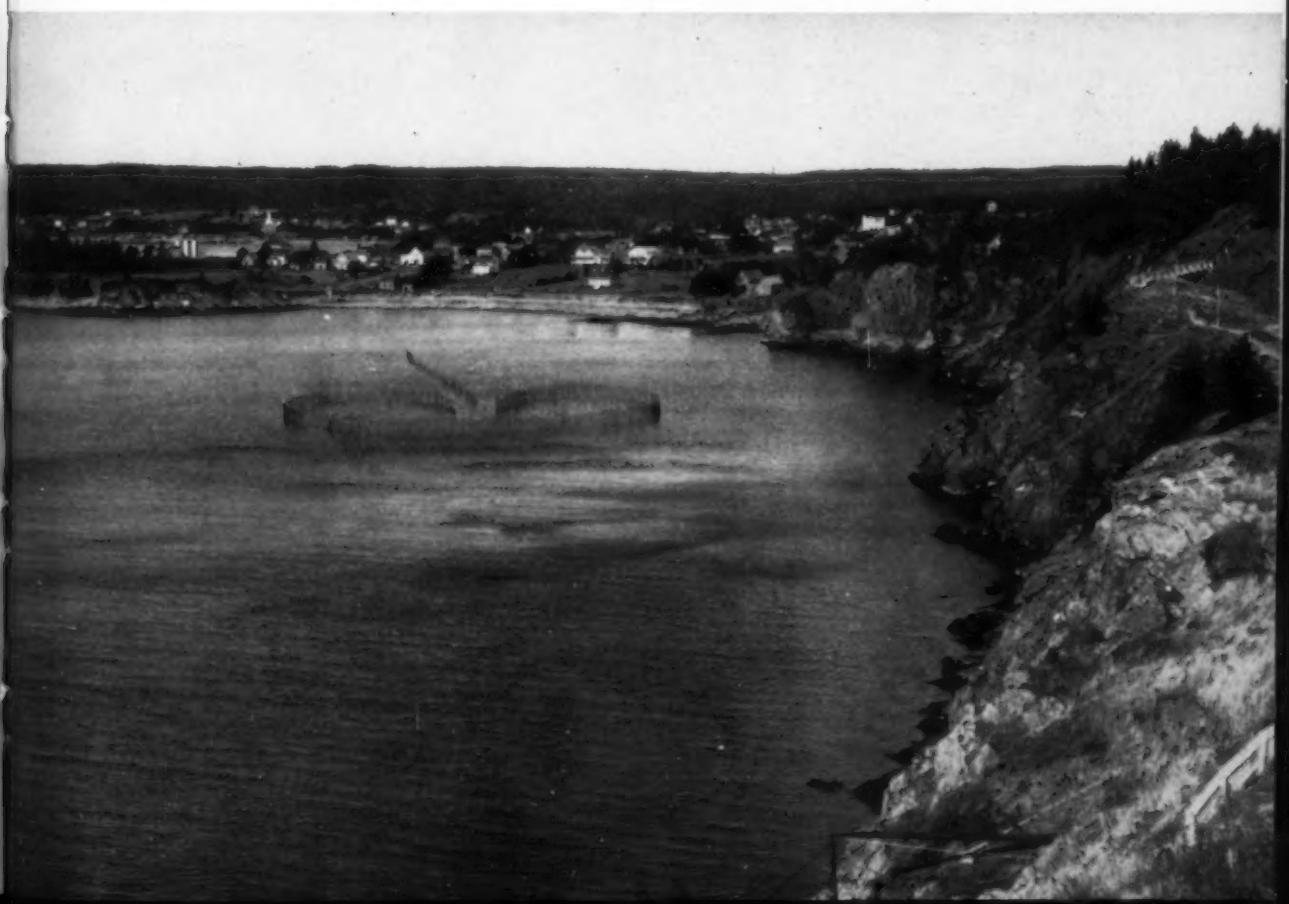
North Head, Grand Harbour, and Seal Cove are the three largest communities on the island. North Head, as already mentioned, is where the boat from the mainland calls which gives it an especial importance. Its beaches kept clean by hundreds of gulls, its cliffs of sedimentary rocks folded and contorted by mountain building movements in past geological ages, its boats, and its fishing scenes offer a variety of pictures that once seen will long be remembered.

One of the most popular walks from North Head is to Swallow Tail lighthouse from which there is an excellent view of the northern part of Grand Manan, of the Wolves to the northeast and of Campobello and other islands to the northwest. The approach is downward by a wooden staircase and a short bridge across a chasm which almost makes the Swallow Tail peninsula an island. In the chasm can be seen a dike of reddish brown diabase cutting the dark volcanic rocks which extend north to Fish Head. The dike is about eighty feet thick and is of Triassic age related to the flows of the western part of the Island. The volcanic rocks which it cuts are believed to be late Precambrian. They rest in fault contact at Pettes Cove with older Precambrian sedimentary rocks which surrounds Flagg Cove.

Another trail leads through woods and along the cliff edge to Hole-in-the-Wall and Fish Head. The former is an arch produced by wave erosion on the dark volcanic rocks which form the cliffs. Whale Cove to the west received its name for obvious reasons. From the top of these cliffs the writer saw, at rather close range, a large whale pursuing its stately up and down course along the coast in front of him.

On the opposite or western side of Whale Cove are the cliffs known as the Seven Days Work. To the geologist they are of very special interest for they consist of lava flows poured out in Triassic time one on top of another. Each flow is well marked off from

North Head as viewed from Swallow Tail. A herring weir is set in the cove.



The Whistle, on the northern tip of Grand Manan

the one that succeeds it by its amygdaloidal top. As the lava cooled, escaping gases left bubble holes in the viscous upper portion of the flow; these later became filled with light-coloured minerals—quartz, calcite and zeolites. These rocks may readily be reached from the pier on the west side of Whale Cove or from a trail down Eel Brook to Ashburton Head.

Ashburton Head received its name from a tragedy that occurred at this point in 1857. On November 17, 1856 the *Lord Ashburton*, a merchantman of 1,000 tons, sailed from Toulon, France, in ballast. On January 19 in a blinding blizzard of snow and wind it ran head on into the 300-foot cliff. The captain and twenty-one members of the crew who lost their lives are buried in the Anglican cemetery at North Head. A survivor, William Lawson, spent the rest of his life on Grand Manan. It is still possible to find on the shore in front of the cliff reminders of this wreck. Rounded boulders and pebbles of a dark bluish-black vesicular rock different from anything that occurs *in situ* on the island are relics of the ballast the ship carried. On March 12, 1872 a smaller vessel, the *Sarah Sloane*, struck just a few rods from where the *Lord Ashburton* had hit and only one member of her crew of eight, a mulatto, was saved. Still another disaster occurred in 1873 when the ship *Humber* of 1,600 tons ended her voyage on the sea-wall of Whale Cove Beach.

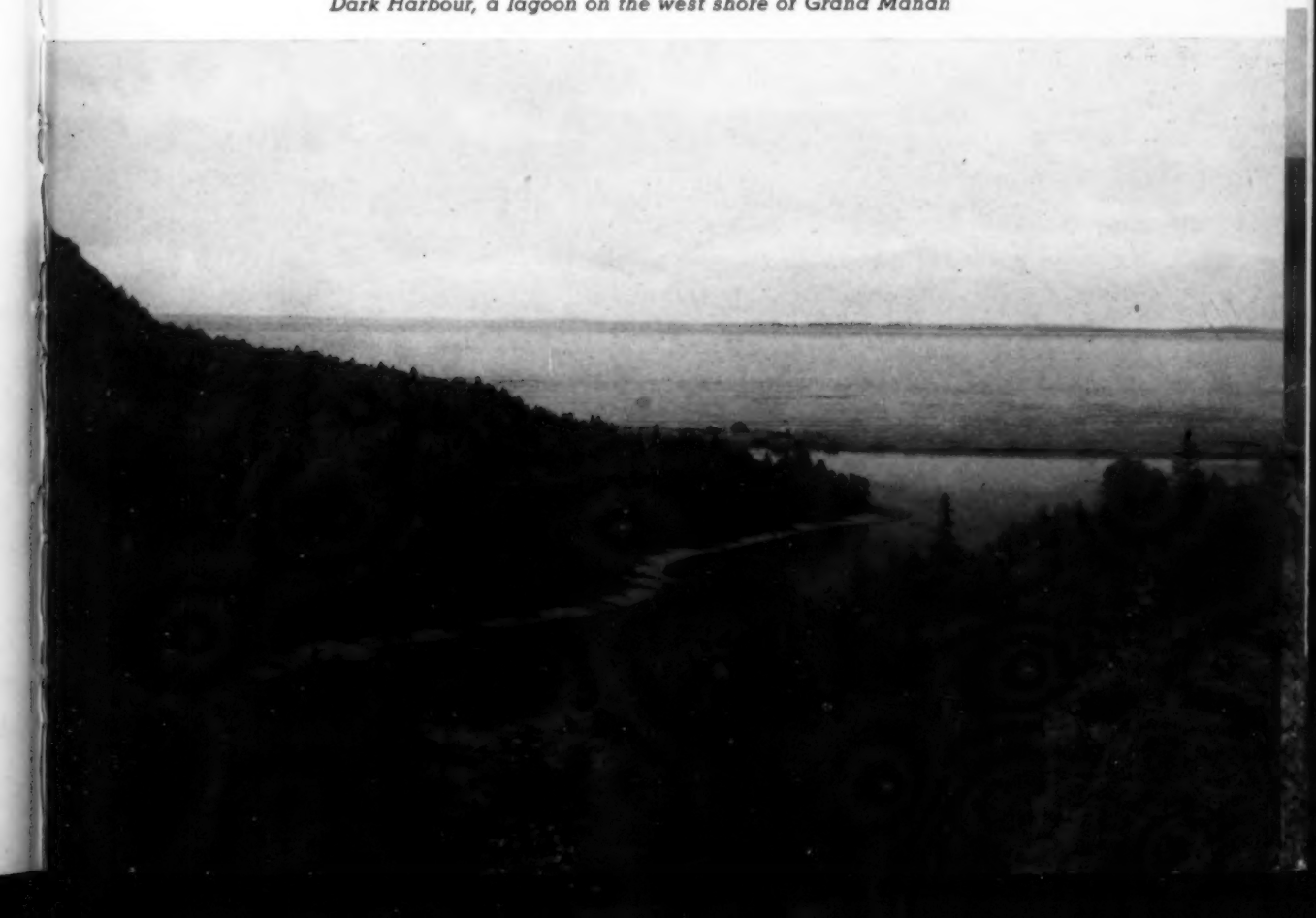
From Tatton's Corner near North Head a road leads north to what is called The Whistle, on the coast just west of Northern Head. Here in foggy weather blasts from a huge horn serve to warn vessels from the dangerous coast. Wooden steps lead down the steep cliff to the shore. Those interested in geology will wish to take a walk of about five hundred feet to the east from the foot of the stairs where a well-marked fault in the Triassic volcanic rocks has dropped down those on northeast side from Northern Head

to Ashburton Head relative to the lavas to the southwest. About half way between The Whistle and Ashburton Head a pinnacle rising from near the water's edge somewhat resembling a figure with a mitred head is known as "The Bishop".

Another road to the west side of the Island leads from Castalia to Dark Harbour. The end of this road descends steeply to the shore. Cars can be taken down it but most drivers prefer to stop at a parking ground on the summit and allow their passengers to go down on foot. The Harbour is a lagoon fronted by a gravel sea-wall with the narrow tickle, or opening to the sea, at the north end. The volcanic cliffs rise to about four hundred feet. In the summer a few people live here in order to gather the edible seaweed "dulse". The plant is plucked from the cliffs, when exposed by the fallen tide, by workers using small boats. It is then spread out on the gravel beach to be dried by the sun after which it is bagged for sale. The dark purple-coloured material is very much liked by most of the local people but visitors usually have to acquire a taste for it.

To the geologist perhaps the most interesting place on the island is Red Head about a mile east of Seal Cove, opposite Wood Island. A motor road leads east from the main highway and across a field to a gravel pit on the shore, on either side of which are outcrops of reddish quartzite standing with steep dips. These belong to an Early Precambrian group of rocks known as the Green Head, the type area of which is Green Head peninsula at Saint John city on the mainland. About five hundred feet to the south along the shore from the end of the road the quartzites are in contact with the Triassic lavas which, as already mentioned, cover about two-thirds of the island. By a fault or dislocation of the earth's crust these youngest rocks of New Brunswick have been dropped down until they rest in knife-edge contact with the Green Head ones, the oldest rocks of the province. The difference in age between the two formations is at least

Dark Harbour, a lagoon on the west shore of Grand Manan



Southern Cross, a rock formation half a mile from Southern Head

a thousand million years. The fault is a normal one with the fault plane dipping about 60 degrees to the northwest. Well marked in the cliff, its course can be traced across the sands of the beach to where it disappears under the sea by a line of low outcrops of the harder Triassic volcanic rocks which have proved more resistant to erosion than the adjacent sediments. The fault strikes northeast to Whale Cove, crossing the Long Pond road at "The Anchorage".

No visit to the island can be said to be in any way complete without a trip to Gull Cliff at Southwest Head or, as it is also called, Southern Head. A car can be taken to the lighthouse which stands near the edge of the

Southern Head, the southernmost tip of Grand Manan

cliff where the land breaks away in a vertical descent of a couple of hundred feet to the sea below. The dark jointed trap cliffs make a most impressive sight. Although in the main the coast is a regular one, in detail there is a considerable variety in the carving that the waves have carried out. Half a mile to the northwest the Southern Cross forms a low pinnacle whose arms were responsible for its name.

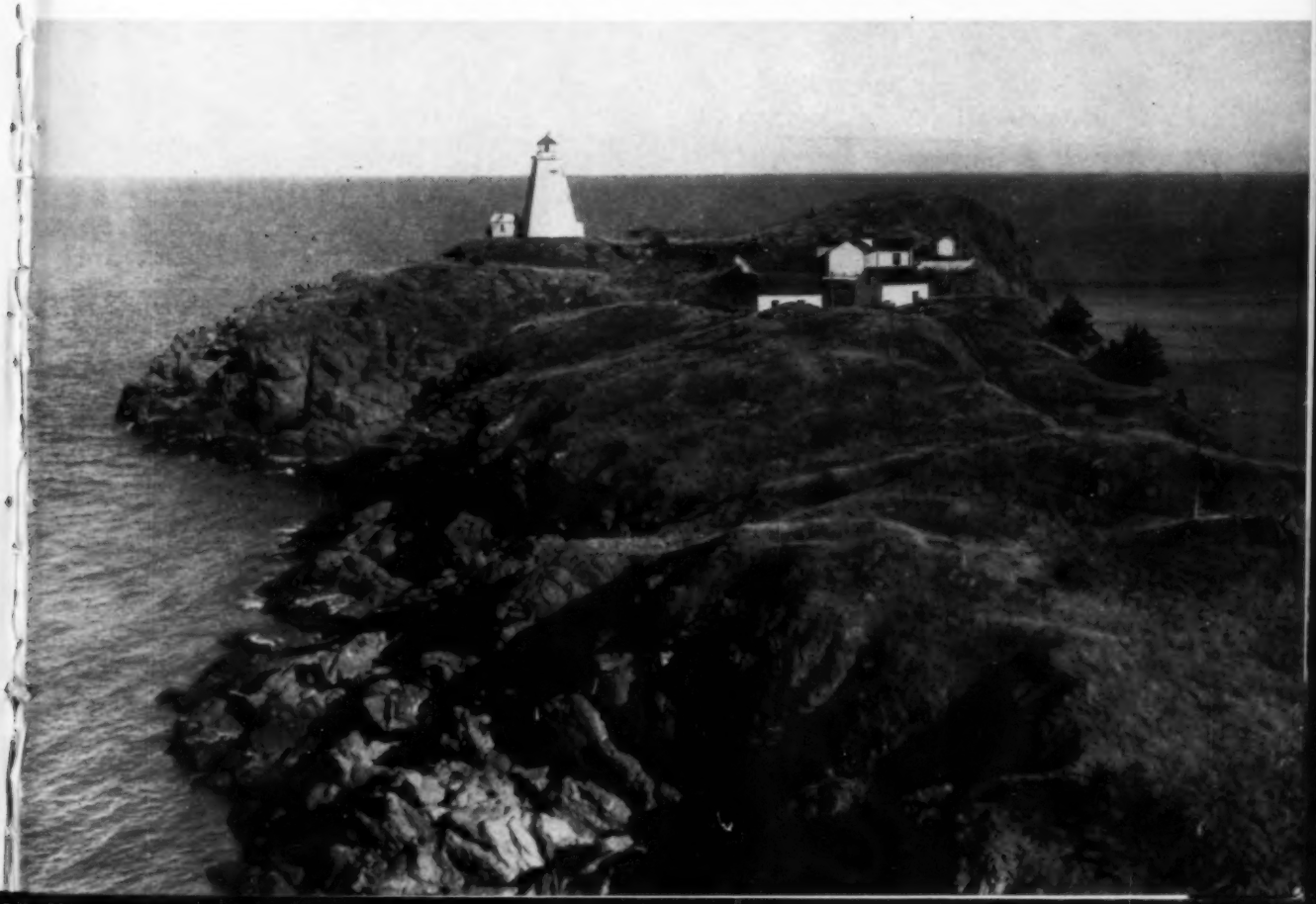
In the southern half of the island two beaches of dark well-packed sand, Deep Cove, and Seal Cove stretching toward Red Head, are favourite picnic sites.

Glacial Notes

All the islands of the Fundy group show abundant evidence of having been overridden by ice sheets during the Pleistocene or Glacial period. Rounded, smoothed, and striated rock surfaces are everywhere common and their roche moutonnée shapes with gentle and polished stoss slopes and more abrupt and irregular lee slopes afford ample evidence that the advance of the ice masses was from the north and the west. At many places more than one set of striae can be seen. Evidently the highland region of the Maine and New Brunswick mainland was a gathering ground for glaciers just as was central Labrador, the region from which the main advance took place. The highest summits of the islands show evidence of glaciation just as do the coasts. Not only are there the erosion features mentioned above but there are also numerous foreign erratics. For example, on the highest part of Grand Manan the Triassic volcanic rocks support huge boulders of granite brought over by ice action from the mainland.

The post-Glacial history was probably marked by a certain amount of uplift of the land. Search was made for clays carrying marine shells that would furnish data on this problem. Information on such occurrence was obtained on Deer Island but other efforts were disappointing.

Swallow Tail Light on the northeast coast of Grand Manan



Associated Screen News

Quebec's Monteregian Hills

by HENRY WILLIAM GENDREAU

WHEN Queen Elizabeth stood on the height of Mount Royal above Montreal, during the Royal visit to Canada in 1939, she pointed to the isolated peaks rising against the eastern horizon, and asked, "What are those mountains over there?" It is surprising how few people would have been able to name this group of eight mountains rising out of the valley of the St. Lawrence, and having, according to geologists, a common origin and formation.

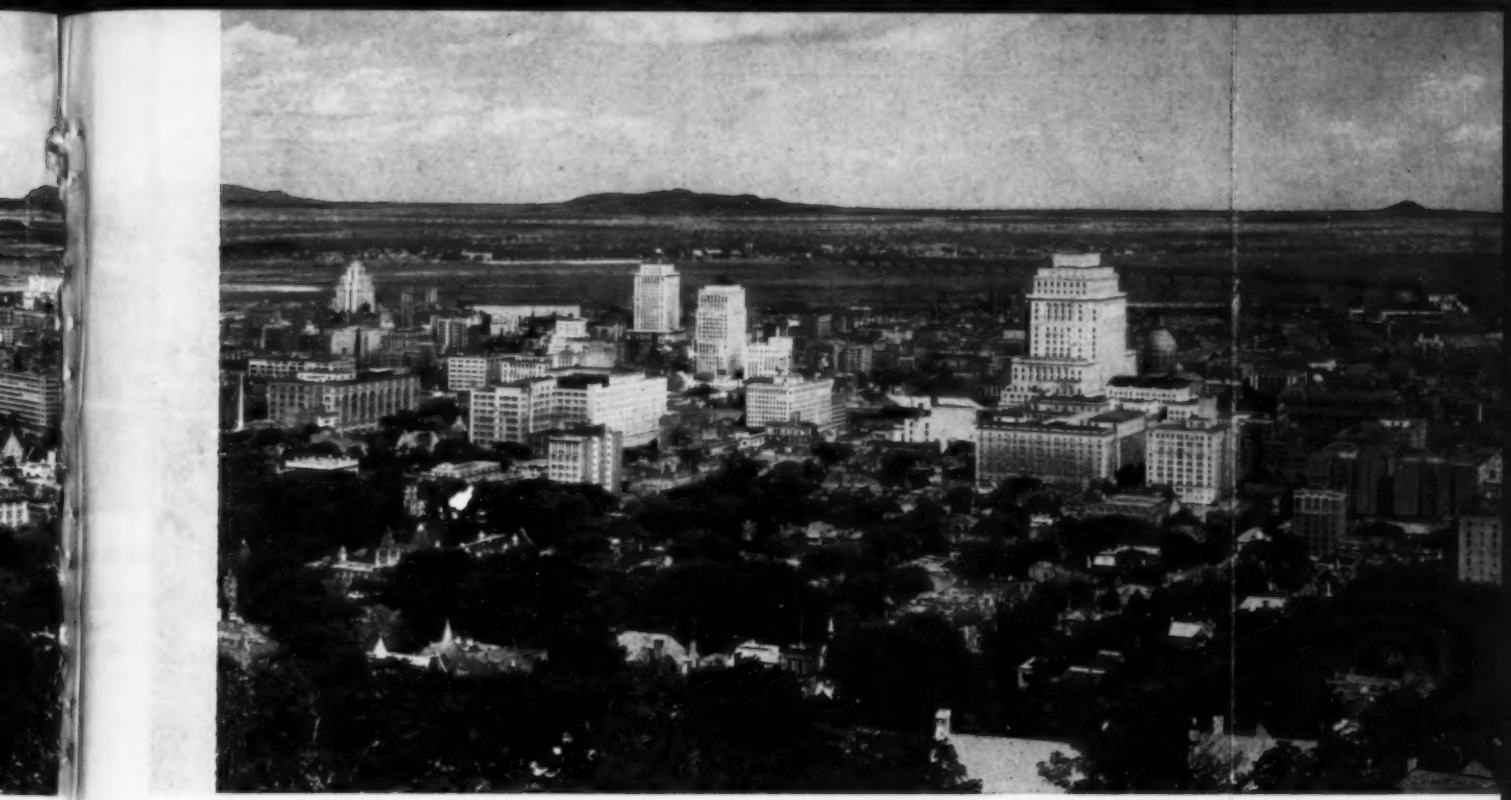
They are the Monteregian Hills, and are quite distinct from the nearby mountains of the Appalachian Plateau which includes the Notre Dame and Shickshock ranges, a continuation of the Green Mountains of Vermont and the White Mountains of New Hampshire.

These eight mountains of the butte type would be considered mere hills in a really mountainous country, but rising abruptly and conspicuously in a low and gently undulating valley, they take on larger proportions and more distinctive heights.

According to geologists, they are the result of igneous intrusions which occurred so many million years ago that the average mind does not grasp its significance. They are composed of igneous rocks and represent the substructures of volcanoes long since extinct. Like the rest of the surrounding landscape, they have been altered by the glacial flows, the marine washes, and the general erosion and corrosion effected by time and the elements.

A general survey of these mountains will show that they all rise abruptly to a high crest on the northeastern side, and slope gradually on the southwest side; due, perhaps, to ice erosion from the first direction, and an earlier and more rapid debacle in the latter direction. The presence of sea-

At top:—Panoramic view from Mount Royal looking eastwards across the city of Montreal and the St. Lawrence River to the distant hills of Mount Bruno, Mount Beloeil and Rougemont.

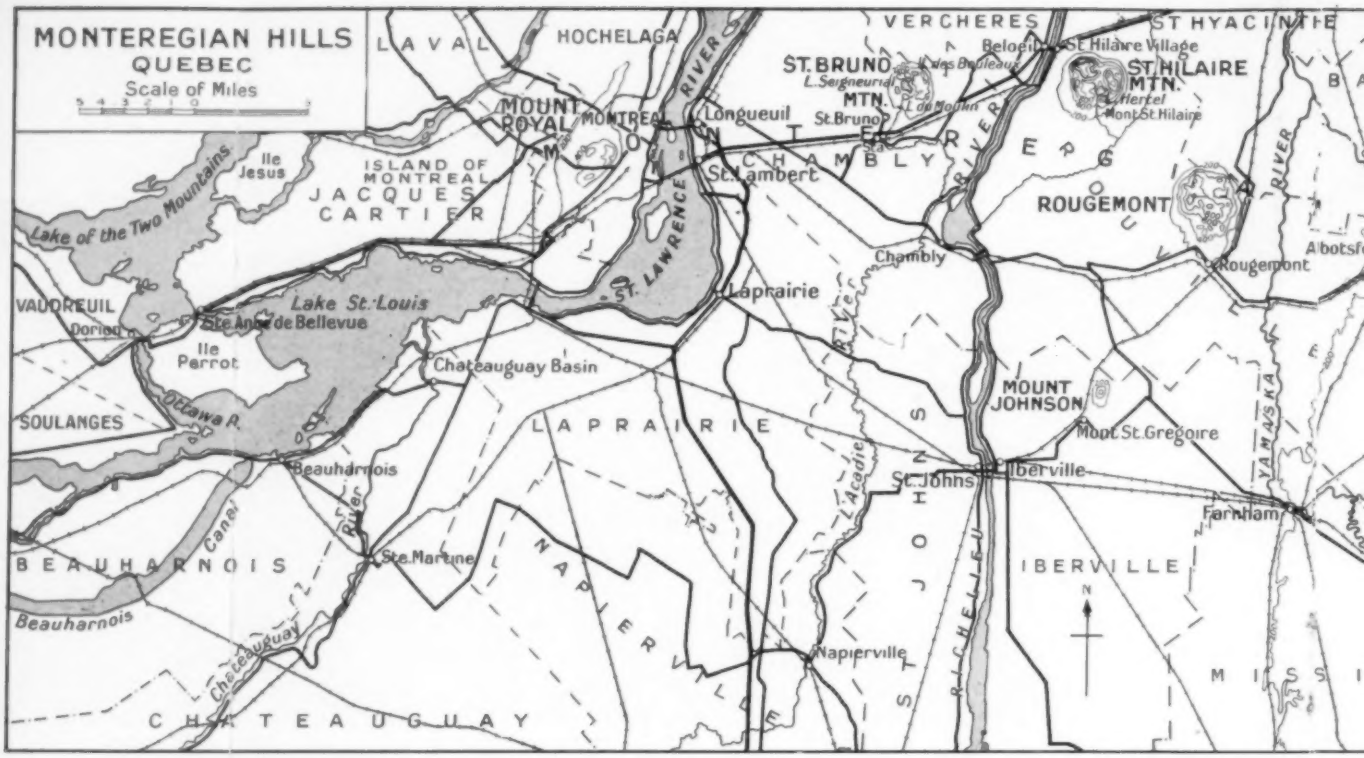


beaches and shells at certain altitudes also indicates that, at one time, they were partly submerged. According to geological reports, a body of water, now referred to as the Champlain Sea, flooded the valleys of Lake Champlain and Lake Ontario, having for its shore-lines the Laurentian Plateau and the highlands of Ontario on the north, and the Appalachian Plateau on the south. The depth of water in the Champlain Sea has been determined by the sea-beaches found along its old shorelines. One of these beaches, found on Mount Royal, shows that this mountain was once submerged to within 200 feet of its summit. Other beaches, found at similar levels, near Roxton, Granby, Dunham, Covey Hill, and on the slopes of Beloeil Mountain, are strong evidences that such a sea once existed. To the imaginative mind, a retrospective view of the St. Lawrence valley would present a wide expanse of water, dotted here and there by steep-crested islands, against which broke the waves of a turbulent sea.

The presence of Champlain terrace gravel on the once-submerged slopes makes the soil well adapted to the culture of apple trees; and a drive through the orchard sections, in the spring when the trees are in full bloom or in the autumn when the apples are ripe, is a rewarding experience.

The Monteregian Hills were named by Dr. F. D. Adams (1903) from the Latin *Mons Regius* (the Royal Mountain), the name given to the best known of the group by Jacques Cartier, upon his first voyage up the St. Lawrence in 1535. The mountains forming this series are Mount Royal, Mount St. Bruno (Montarville), Beloeil Mountain (Mont St. Hilaire), Rougemont, Yamaska, Shefford, Brome, and Mount Johnson (Mont Noir).

The first seven mountains, seen from the air, stand in an irregular and slightly curved line from east to west and seem to form a crescent; while the eighth, little Mount Johnson, stands like a star between the two points of the crescent. But a more exact statement of their respective positions and their relation to one another in the petrographical system is given by Dr. F. D. Adams in his report on the Monteregian Hills. He writes: "It is highly probable . . . that these ancient volcanic mountains are, as is usual in such occurrences, arranged along some line or lines of weakness or deep-



The Monteregian Hills District

seated fracture. The 'pretty nearly straight line' referred to by Logan (Geology of Canada), on which the first six mountains of the group are situated, must be considered either as a single line with a rather sharp curve in the middle or as made up of two shorter straight lines, each with three mountains, diverging from one another at an angle of about 30°, with Montarville (Mount St. Bruno) at the point of intersection. Mount Johnson and Brome Mountain might then be considered as situated on short subsidiary fractures."

To those, however, who have been born and raised among them, they are not geological specimens to be analysed but "The Hills of Home"—first looked upon with wonder and awe, then with curiosity and interest, and finally with love and a deep sense of reverence. In all their aspects and their moods they are appealing, drawing us from the common levels to more sublime heights. To live intimately with them is uplifting, for their wooded peaks are always inspiring, and their winding paths constantly invite us to ascend.

Mount Royal

When Jacques Cartier first saw the green elevation of Mount Royal rising out of the blue waters of the St. Lawrence, under the skies of New France, he was inspired to give it the name it still bears. This mountain is indeed a royal gem, in a setting of rare beauty: a gem varying in colour from deli-

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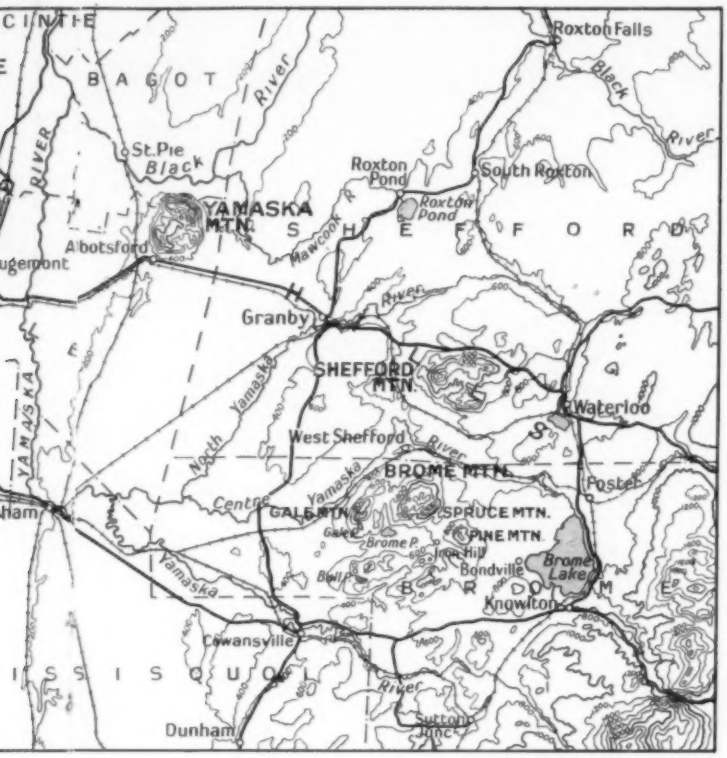
The Lookout, Mount Royal



Canadian Geographical Journal Map

cate green in spring and summer to vivid shades of red, yellow, and green in the autumn, and sparkling white in winter; a gem set in a cluster of architecture

Mount Royal has a wide domain, for it commands a view of the valleys of the St. Lawrence, the Richelieu, the Yamaska, the Chateauguay and the Ottawa Rivers, and the hills beyond. It also surveys most of the traffic that moves by rail, by road, by air, and by water—in, out, and through the Dominion. At its feet are clustered more than one-tenth of the population of Canada. It is the most westerly of the Monteregian Hills and covers an area of about two square miles, rising to 769 feet above sea-level. From the mass resulting from two main intrusions through the earth's crust at this point, Time and Tide have left but three small peaks to mark the prehistoric occurrence. These peaks are Mount Royal, Westmount, and Cote des Neiges, in Montreal.

Mount Royal Peak, crowned by its illuminated cross, is almost wholly occupied by Mount Royal Cemetery and Mount Royal Park. With its network of attractive trails, winding among majestic trees, flowering shrubs and inviting shady knolls the park is a bit of the country in the heart of a big city. It is visited by thousands of people every day. In summer, sightseers, hikers, picnickers and riders find relief from the heat, noise and dust of the city streets. Fine concerts are regular features at the Chalet on warm summer nights. In winter, its slopes offer a playground for skiers and amateurs of other winter sports.

Until recently the mountain could not boast of a lake, but there was an abandoned beaver pond in the park which had dried up when the beavers were no longer there to maintain the dam. This has now been restored by human hands into a beautiful artificial lake which still bears the name of Beaver Pond. Onits shore, open air theatrical presentations are given in summer.

Access to Mount Royal Peak is by cab or tally-ho over the mountain drives where motor cars are not allowed; by tramway, to the station at the centre of the park; or by motor car, as far as the end of Shakespeare Road where good parking space is provided. The most exhilarating way to ascend, however, is to climb one of the stairways that lead to the principal points of interest.

Associated Screen News

The Chalet, Mount Royal

Left:—Beaver Pond,

Above:—Mount Royal from

Right:—The Old Mill,

Associated Screen News

Westmount Peak is occupied by private homes almost to its summit. Whether built along straight, level streets, or along steep, winding avenues, the residences on upper Westmount are renowned for the beauty of their architecture and for the attractiveness of their grounds.

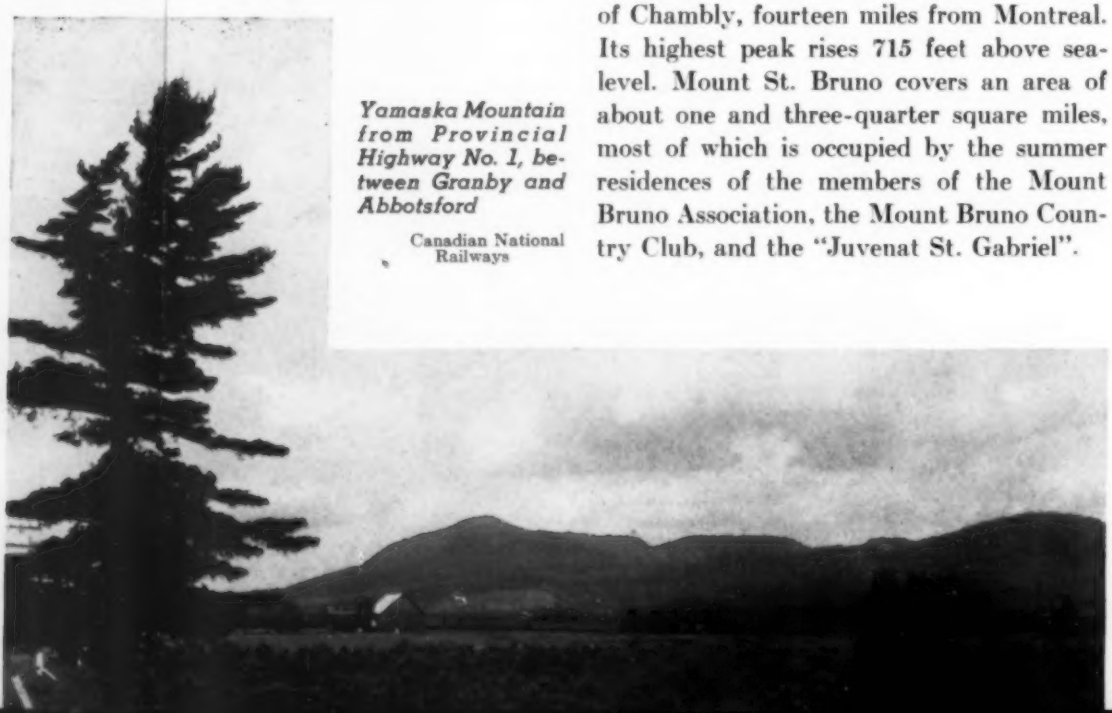
On the south side of Summit Circle is a lookout on the parapet of which are brass arrows which indicate and give the names of the various points of interest seen from that vantage. On the western slope near Cote des Neiges Road is the ski-jump of the Montreal Ski Club.

Cote des Neiges Peak is partly occupied by the Roman Catholic Cemetery of the same name, and by the University of Montreal. Some of its wooded hills are still free to the public.

Mount Royal, most sophisticated of all the Monteregian Hills, is to Montrealers both a place of activity and of rest. And when, for some, the long day is done, they are laid to sleep in the stillness of one of its most beautiful and peaceful valleys.

Mount St. Bruno
(Montarville)

Mount St. Bruno is located in the County of Chambly, fourteen miles from Montreal. Its highest peak rises 715 feet above sea-level. Mount St. Bruno covers an area of about one and three-quarter square miles, most of which is occupied by the summer residences of the members of the Mount Bruno Association, the Mount Bruno Country Club, and the "Juvenat St. Gabriel".



Yamaska Mountain from Provincial Highway No. 1, between Granby and Abbotsford

Canadian National Railways

...t Royal Park

...cGill University campus
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...unt St. Bruno

Photo by the author

Its basin contains five beautiful lakes, the largest of which is Lac Seigneurial, covering an area of over eleven acres. The others are Mill or Daisy Lake, Lac des Bouleaux or Lac Rond, Lac des Atocas, and Lac des Tortues.

The original name of this mountain was Montarville for it was the seat of the Seigneurie de Montarville, granted by the King of France to Pierre Boucher de Boucherville about 1700. It was recorded that "the first Seigneur of Montarville built a mill of timber on the site in 1710". It is further recorded that "in 1741 the second Seigneur, René Boucher de la Bruere, rebuilt this mill in stone", and in May 1746 he recorded in his own hand: "I planted seventeen apple trees and sowed two bushels of grain. This is the first ploughing in the Seigneury. God grant that it be an example for many to follow". His plea was certainly granted for besides the grain produced, some half million apple trees are now producing fruit in the Monteregian Hill district.

A seven panel tablet on the wall of the Old Mill records the changes and the principal events that have occurred in the Montarville Seigneury since its inception. The Manor House and the Old Mill were occupied by the rebels in the 1837-38 political rebellion. The Manor House disappeared some fifty years ago, but the Old Stone Mill still stands. It has been restored and converted into a place of worship and recreation, and it contains many objects of historic value.

Although most of the government reports on geological surveys refer to this mountain as Montarville, the names Mount Bruno and St. Bruno seem to have gained in popularity during the last few decades, due no doubt to the influence of the village situated at its base. St. Bruno, the name of the village, is probably a corruption of Bruneau, with the ecclesiastical prefix added; for the village

Campbell Lake on Beloeil Mountain, looking toward Mount St. Bruno, with the Richelieu River in the valley.

Canadian National Railways

Rougemont, as seen from the south

Photo by the author

came into being and the parish was established after the Hon. F. P. Bruneau purchased the Seigneury in 1829.

The attractiveness of certain parts of Mount Bruno demonstrates what the artistic ingenuity of man can do to preserve and enhance the beauties of nature; for the landscaping has been done with the object of perpetuating and not destroying its pristine glory.

Beloeil Mountain
(Mont St. Hilaire)

As we journey eight miles from Mount Bruno to Beloeil Mountain the striking beauty of that prominence fully justifies the name bestowed upon it by the early settlers. The grandeur of Beloeil Mountain, seen from across the Richelieu River, makes an impression not soon to be forgotten.

It is said to be the remains of two main volcanic intrusions, eroded, altered, and beautified by time. Like that of most of its sisters, its outline is in the form of a horseshoe, opening towards the southwest. A central basin is formed by its four main elevations, which are of equal height; but the most frequented of its peaks is Sugar Loaf, overlooking the Richelieu valley and its many villages. From the vantage point of this peak, the vari-coloured patches of farm land and wood lots below give the appearance of a gigantic chess-board, with buildings standing like chess-men on the squares.

Beloeil Mountain covers an area of nearly seven square miles, and has a maximum elevation of 1,437 feet above sea-level and 1,230 feet above the plain. In its interior basin is Hertel Lake, a beautiful sheet of water a mile and a quarter in circumference; from Sugar Loaf it looks like lapis lazuli in a setting of green gold. This lake, as well as most of the mountain, is privately owned. About half a mile below the lake is the quaint little village of Mont St. Hilaire, which should not be confused with the larger village of St. Hilaire, lower down the river. The mountain is also sometimes called St. Hilaire.

Around its base and on its lower slopes are some of the best apple orchards in the province.

Rougemont

A valley of four miles divides Rougemont from Beloeil Mountain. It was probably named Mont Rouge or Rougemont (Red

Shefford Mountain, from the town of Waterloo

Canadian National Railway

Mount) by the early settlers when the maple trees were in their autumnal splendour.

Rougemont is the result of one main intrusion, according to geologists. It is located almost in the centre of the County of Rouville, and it covers an area of nine and a half square miles. Its highest peak rises 1,250 feet above sea-level and 1,140 above the plain. There are two lakes on Rougemont, the larger on the southeastern slope and the smaller in the basin on the western side.

The upper part of the mountain is still quite heavily wooded, and its cultivated slopes are covered by orchards. The soil of Rougemont is well adapted to fruit growing, and it ranks high in the production of apples. The area is also well known for its maple products.

At the base of the mountain is the village of Rougemont, the main street of which is lined with booths offering fruits, vegetables, flowers, honey, and maple products, in season. Throughout the summer and fall the village appears to be holding a continuous fair. Rougemont is also gaining popularity as a ski centre.

Photo by the author

Row upon row of apple trees, Rougemont

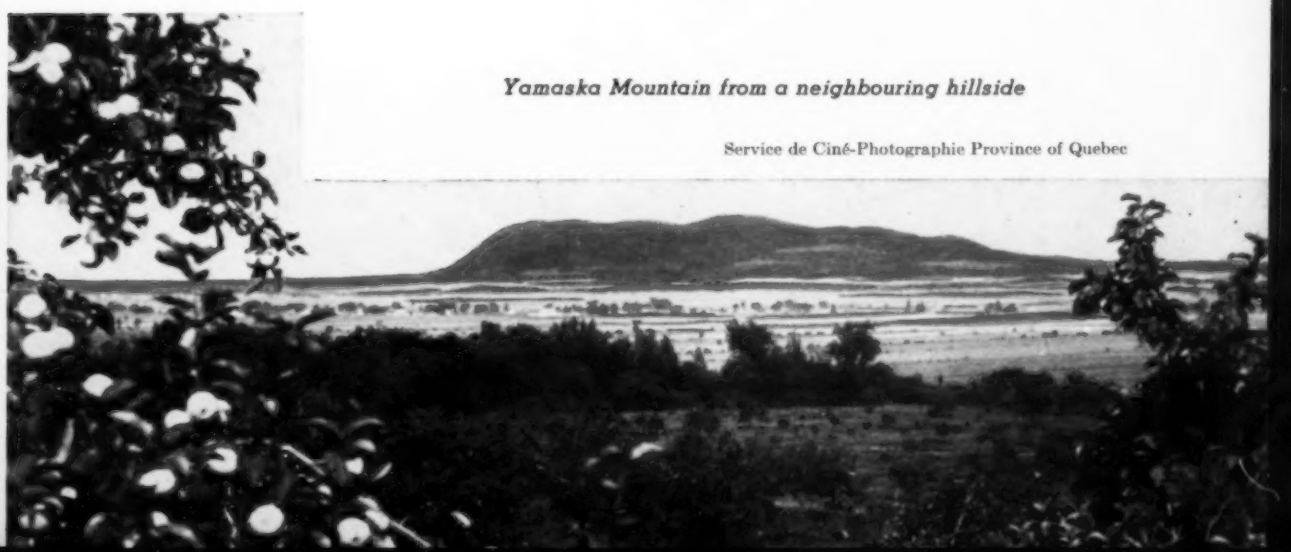
Yamaska Mountain

Situated about eight miles from Rougemont, Yamaska Mountain is the third of the series in the County of Rouville while a fourth (Mount Johnson) borders upon it. This might give the impression that Rouville is a very mountainous county, but, on the contrary, the land between these abrupt elevations is very flat.

Yamaska is nearly circular in outline, and is formed by two parallel ridges which run northwest to southwest, and are connected in the centre by a lower and somewhat broken ridge which runs at right angles, forming the letter "H". This symmetrical form is marred, however, by an isolated peak on the eastern side, midway between the two main ridges. It covers an area of five and a half square miles, and its highest elevation is 1,470 feet above sea-level. Like its neighbour, it has two lakes—the larger in the eastern part of its basin, and the smaller in the western part.

While its high slopes are still fairly well covered with deciduous and some coniferous trees, its lower slopes are lined with multiple rows of apple trees, for it vies with Rougemont and Beloeil in apple production.

Yamaska forms an immediate background to the village of Abbotsford (often referred to as St. Paul), situated on the southwest side, and a more distant background to the village of St. Pie, on the north side,



Yamaska Mountain from a neighbouring hillside

Service de Ciné-Photographie Province of Quebec

Right:—Mount Johnson from the village of St. Gregoire.

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Province of Quebec

Below:—Gale Mountain, part of Brome Mountain

Photo by the author

from which it is separated by Black River, a tributary of the Yamaska.

The name Yamaska is of North American Indian origin, but its meaning is not definitely known. It is significant, however, that the word *yama* stands for mountain in Indian and other languages. For instance, Yamachiche is translated as "Mountain of Clay", while Fuji Yama is translated from the Japanese as "Mountain of Fire". Whatever its meaning, the name has a magical charm, and it is hoped that it will not meet the fate of many other historical names. There is great danger of this, however, for when strangers ask the name of this mountain, it is usually given by the inhabitants of the area as La Montagne de St. Pie or La Montagne de St. Paul, according to the side of the mountain where they happen to be.

Shefford Mountain

Eleven miles from Yamaska, on the brim of the Appalachian Uplift, rises Shefford Mountain—one of the two Monteregian Hills which made their appearance just outside the Champlain Sea basin.

Shefford seems to be the result of three plutonic intrusions, from which natural erosion has left a heap covering nine square miles of territory in the County of Shefford. It has a maximum height of 1,725 feet above sea-level, but it appears lower due to the hilly country that surrounds it, and to cultivation which has crept up its slopes, even into its centre valley, where a road intersects it. The wooded portions of the mountain are mostly of maple growth, and they produce a bountiful harvest of maple syrup and sugar every spring.

Lake Coupland, on the northwest side of the mountain, supplied the city of Granby with water till recently, when it went dry for the first time in its history.

Shefford Mountain furnishes splendid opportunities for skiing, and two clubs have been established on its slopes.

Brome Mountain

Brome is the most easterly and the largest of the Monteregian Hills; its three intrusions have left remains that spread over an area of thirty square miles. At close range it looks more like a group of connected hills than a single mountain, for these hills or peaks rise from the cultivated farm lands, dotted here and there by attractive homes and well-kept farm buildings. The principal elevations are Gale Mountain, Collier's Hill, Spruce Mountain, Pine Mountain, and Iron Hill—the highest of which is Pine Mountain, 1,755 feet above sea-level.

Inside its main basin is Brome Pond (not to be confused with Brome Lake). A small summer colony has been started near this pond and it is growing and gaining in popularity. There are two other small lakes on the west side of the mountain, Gale Pond and Bull Pond.

Brome Mountain is located in the County of Brome, with its western fringe in the County of Missisquoi, and a narrow strip of its northern fringe in the County of Shefford. It is separated from Shefford Mountain by a narrow valley, through which runs the middle branch of the Yamaska River; in this valley nestles the village of West Shefford.

Right:—Springtime in the Monteregian Hills

Canadian National Railways

A few miles from Brome Mountain is Brome Lake—one of the most attractive resorts of the Eastern Townships. The area covered by Brome Mountain is traversed by many roads, which afford lovers of nature access to some of the finest scenery in the district.

Mount Johnson

Mount Johnson in the County of Iberville is the smallest of the Monteregian Hills, covering only about half a square mile. Its height is 875 feet above sea-level and 720 feet above the plain; but its complete isolation in a perfectly flat country makes it appear higher. It is the result of a single intrusion, and it is referred to by geologists as the neck or plug of an extinct volcano. It derived its name from one of the early English settlers, but the French had another name for it, Monnoir, probably a corruption of Mont Noir (Black Mount), in opposition to Mont Rouge or Rougemont, its nearest sister. A few years ago, before Mount Johnson was partly denuded of its coniferous growth, it had a very dark appearance which might well have suggested the name. It is also erroneously called La Montagne de St. Gregoire, after the small village of that name situated nearby.

The soil at the base of the mountain is well adapted to the culture of apple trees, and some very fine orchards have been developed on its lower western slope.

From Mount Johnson, it is only twenty-two miles to Montreal, and we have completed a tour of the Monteregian Hills. Besides being a valuable heritage to our present age, they offer to science a valuable record of ages past. And while the common man enjoys their thrilling beauty and the products derived from their soil, the man of science searches their many tiers and folds and layers of rock, sediment, and growth, to learn the amazing story of an evolving world.

A chiclero tapping a sapodilla tree to collect the latex.

Chicle

by E. O. HOPPÉ

Photographs by the Author

NEXT TO TIMBER, chicle is British Honduras's most valuable natural resource. This is the gum, or latex, of the indigenous sapodilla tree and is the basic ingredient of modern commercial chewing gum. In these days of instability it has become an important dollar earner as almost the entire season's crop is exported to the United States and to Canada. Besides this use the gum is of great value in the manufacture of surgical tape, in dental supplies and in certain phases of commercial chemistry. The Concessions fees, plus the export duties on chicle form a very considerable revenue to the Colony. The value of exported chicle in 1940 amounted to more than $40,000.

Sapodilla trees are slow-growing and are found scattered over wide areas. There are two principal varieties of resin-yielding trees, the *Achras zapota L.* which grows in the northern forests and the chiquibul and chicle macho trees of the southern districts of the colony especially in the San Pedro area where the rainfall is much higher. The latex of the latter is known as "Crown Gum" and is considered of slightly inferior quality, as it hardens slowly and melts easily. The two gums vary in colour; that obtained from the *Achras Chicle pittier* is a creamy-white, while that of the chiquibul is reddish in colour. However, the two resins are now frequently mixed.

The sap is obtained by making a V-shaped or herringbone incision into the trunk of the tree with a special sharp knife or the machete and catching the milky juice in a rubber-coated bag which has been fastened at the base of the tree. In some of the privately owned forest areas crude methods of tapping known as "girdling" still survive from

former wasteful days of exploitation; this consists of cutting completely around the trunk of the tree, which will bring about its death. However, scientific bleeding operations are now strictly enforced in the Government Reserves, and specially trained foresters—often recruited from the ranks of chicleros—act as overseers and instructors in the new technique the object of which is to obtain the maximum amount of sap while doing the least possible damage to the tree. Once a tree has been tapped it must be left untouched for a period of from three to five years before it may be tapped again.

The best sap-harvesters (known as chicleros) and experts in bark splitting are usually forest Indians. These men spend part of the year in the damp, oppressive heat of the rain forests. Frequently they work in small gangs from camps which they move as soon as the available trees in one area have been tapped. This generally happens every two or three weeks. When a sufficient quantity of latex has been collected it is poured into a large iron pot and slowly boiled to remove excess moisture until it coagulates. During this setting process the chicle must be continually stirred with wooden paddles. After the proper consistency has been obtained the mass is poured into oblong wooden moulds where it cools and sets into hard blocks or *marquetas* which must bear the signs or initials of their owners. The bars, or blocks, are wrapped in rough canvas and are then ready to be taken to the contractor's collecting base. Often, this means a journey of several days through dense jungle forest, with heavily loaded mule packs or even by shoulder pack weighing 200 pounds per man.

The latex is poured into an iron pot, heated by a wood fire, where it is boiled to remove excess moisture.

As the chicle sets it has to be stretched at frequent intervals.

Chicle-bleeding is contract work and takes place during the wet season, namely, from August to December as it is only then that the sap flows freely. Before going into the bush, the chiclero agrees to deliver to his contractor a specified weight of chicle bars at a certain price per pound, usually in the neighbourhood of ten cents. Although the

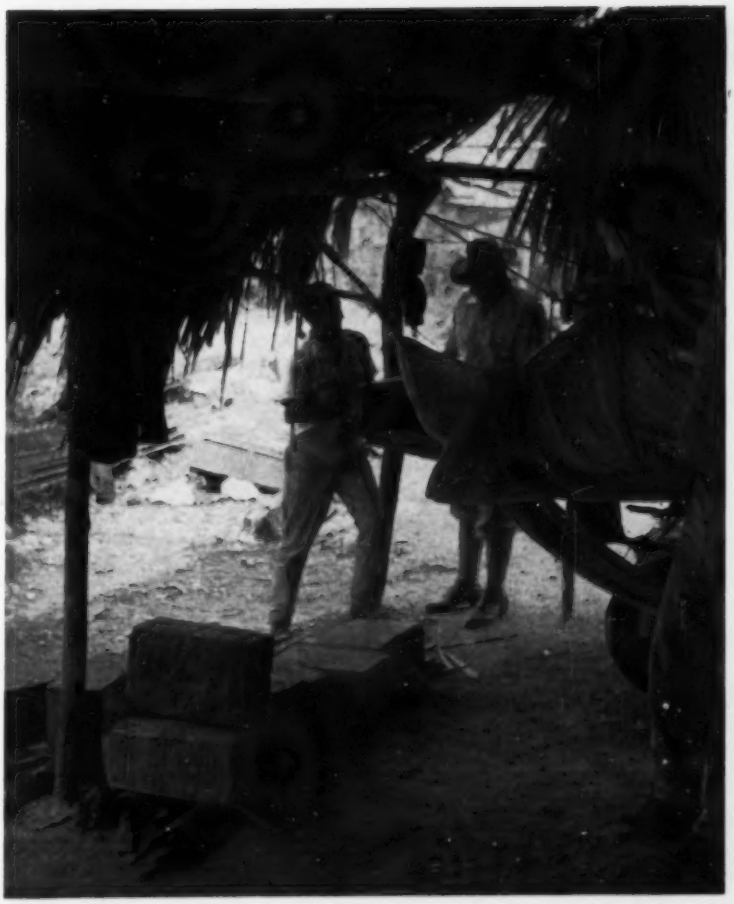
The pack-mule is loaded with chicle to be taken to the contractor's collecting base.

sap-harvesters earn more money during the four months' season—it is not unusual for a chiclero to make $700—than they do in twice that time at home at other work, they almost invariably spend it all within a short space. In order to provide themselves with the essential provisions, they usually demand an advance payment before beginning operations.

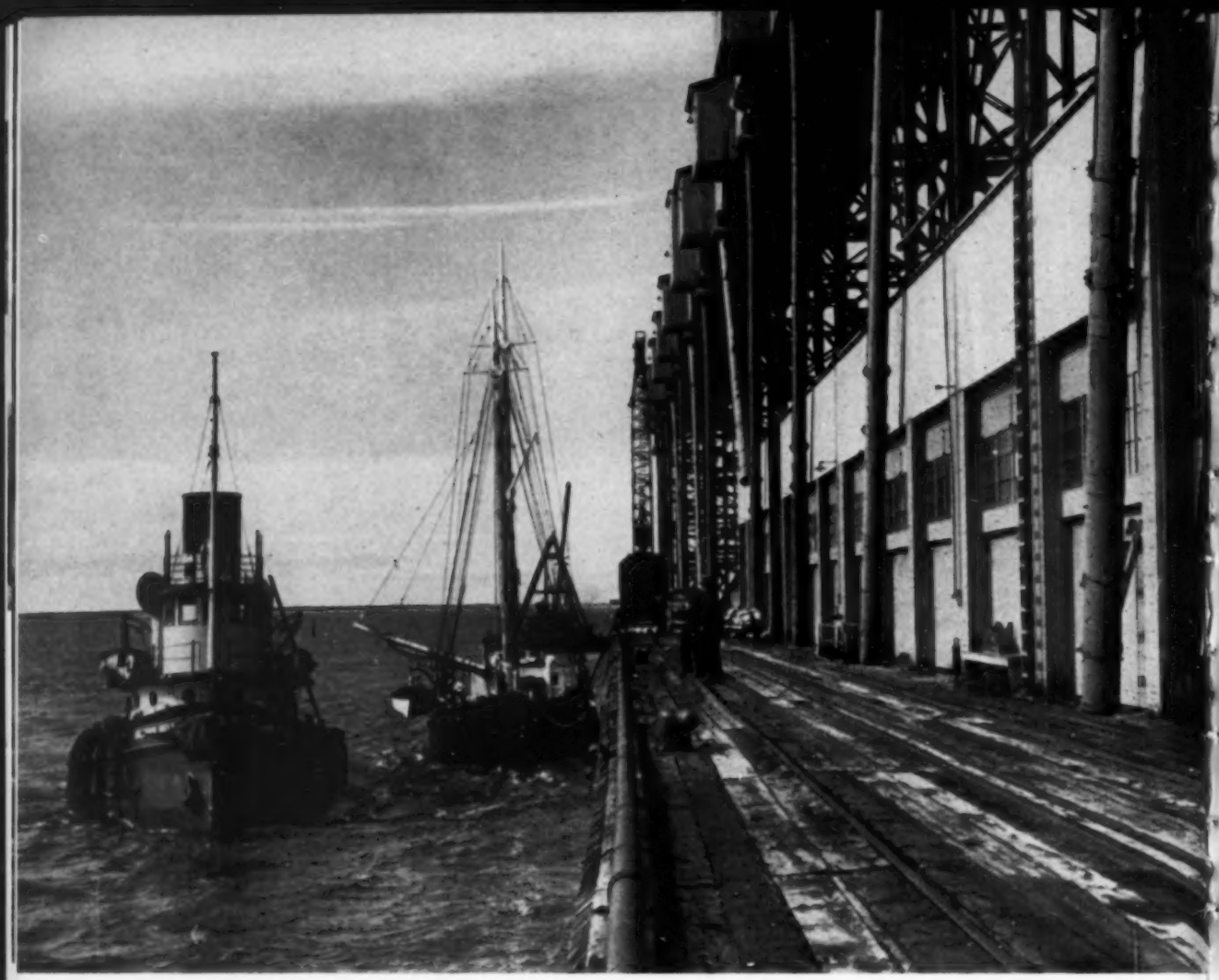
The blocks of chicle are wrapped in canvas for transportation by mule or by human pack.

A chiclero brings in bags of latex. His journey may often take several days.

When a sufficiently large quantity of chicle bars has been received by the contractor at the *hato* or collecting base he delivers them to the local representative of one of the big chewing gum manufacturers. Each contractor must hold a "bleeding" licence which is issued to him by the Conservator of Forests.



Hard blocks of chicle, set in wooden moulds after the heating process, in the chiclero camp.



Richard Harrington

Churchill, Manitoba

by M. Y. WILLIAMS

Photographs by the author except where otherwise credited

CHURCHILL IS UNIQUE: a seaport near the geographic centre of Canada, it is the only deep water railway terminus on Hudson Bay, and the most northern rail-connected port in the Dominion. Its distance from Liverpool by sea is 2,930 miles, as compared with 2,760 for Montreal. Although situated in Manitoba in latitude 58°45′ it lies just north of the edge of the forest belt and therefore falls into the classification of the "Eastern Arctic". Although ice bound for much of the year, Churchill is an important grain shipping port during August, September and October. Established in 1717 as a Hudson's Bay trading post on the boundary between Eskimo and Indian tribes, Churchill has for more than two and one quarter centuries been the starting point for geographical and scientific expeditions. It is maintaining its importance with its modern port, weather station, military establishment and airfield.

The population of Churchill varies with the season. A small permanent business community is augmented by the government employees at the meteorological station, the radio station and the mounted police headquarters, and by railway, dock and

At top:—Churchill's grain dock, which can berth three ocean freighters. The harbour tug and Hudson's Bay Company's Fort Severn *are alongside.*

elevator officials and workmen. The latter are greatly increased in numbers during the shipping season. Trappers and Indians have cabins on the outskirts of the town, where they spend their summers. Two houses and a boat-building shed are located at Cockles Point on the west side of the harbour, and Indians have shacks near Sloop Cove, where visiting natives also camp.

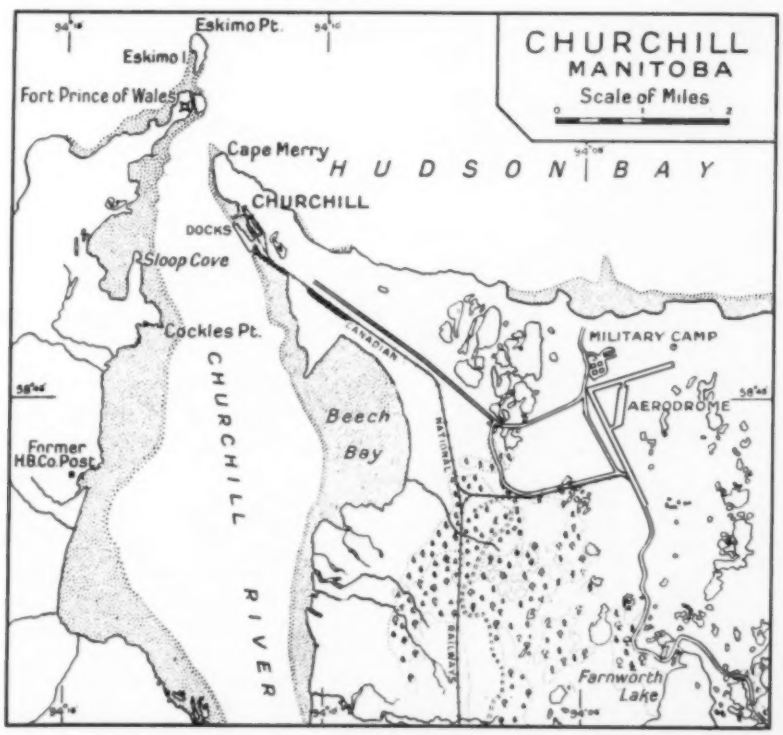
Churchill has two small hotels, four stores, restaurants, a Catholic mission and an Anglican church and rectory. The military camp and airport, some five miles to the south, provide hospital and medical facilities. Military buses connect the two communities.

Geology

The geography of Churchill was predetermined in Precambrian time when the sand of the Churchill quartzite was deposited in a geosyncline or unstable basin. This is estimated as more than six hundred million years ago. After the sand was compacted into rock, great compressive forces in the earth's crust thrust it into folds, anticlines and synclines. Subsequent erosion removed higher and softer beds from the geosyncline to form the valley of the ancestral Churchill river. Shallow seas of later Ordovician time flooded the area, laying down their white dolomitic muds and in early Silurian seas reef corals fastened themselves to quartzite ridges. No legible records remain of later Paleozoic, Mesozoic or earlier Tertiary time. Lignite reported from a locality some 35 miles southeast of Churchill may prove to be of the same age as the Onakawana lignite of the Moose River valley. If so, swamps existed in the vicinity in lower Cretaceous time. Generally speaking, the records of some three hundred and fifty million years have been removed by erosion.

In Pliocene time, perhaps a million years ago, the land gradually rose, and the ancestral Churchill joined other rivers which flowed over the great Hudson Bay plain to empty into the north Atlantic via Hudson Strait. North America stood high, the climate became cold, and down came the snow.

Snow! Snow! Snow! Much more snow fell during the long cold winter months than could possibly melt during the short cool summers. Hundreds of feet, thousands of feet, of compacted snow or névé piled up until the lower layers flowed under the dead weight of the overlying mass. The very land itself, with its underlying rocks, was depressed below sea level and the great basin of Hudson Bay took shape, howbeit full



Interior of Fort Prince of Wales, with the harbour entrance beyond.

Ruins of Hudson's Bay Compalding

of ice. The great Keewatin ice sheet moved south into the United States, retreated far to the north, and advanced again, repeating these manoeuvres during nearly a million years. On its fourth and last retreat the ice front left the site of St. Paul, Minnesota, about 25,000 years ago and has gradually continued northward to its present strongholds in Baffinland, Greenland and other arctic islands. Moraines and glacial scratches indicate three of the later ice movements—from the east, northeast and north.

Aerial view of the ruins of Fort Prince of Wales, looking southeast. R.C.A.F. photograph

As the ice melted it was replaced by water in the great Hudson Bay Basin, which was then much larger than now. The plastic crust of the earth gradually adjusted itself to the lessening load and rose some 350 feet or more, leaving raised beaches and remains of sea shells far inland. The great cold of the ice age and the long post-glacial winters drove the frost line deep into the gravels and sands resulting in the "permafrost" of today. The interior continental climate, the arctic currents which sweep anti-clockwise around Hudson Bay, and its frozen condition for seven months of the year, explain the southerly dip of the tree line and the summer isotherms.

Canada is still recovering from the long superwinter of the ice age. The denuded areas, with their frozen subsoil, have yielded slowly to drainage adjustment and myriads of lakes, large and small, and ill graded streams cover a land once as well drained as Texas. Trees are slowly seeding their way northward, the hardiest species, black spruce and larch, in the lead. Small dwarf willow a few inches high spread out ahead with ground birch, bog laurel, labrador tea, a few grasses and other plants including orchids. Mosses and lichens continue on and on to the northward, furnishing food for the migrant barren land caribou.

Compuildings inside Fort Prince of Wales.

Old powder house near battery on south side of harbour entrance.

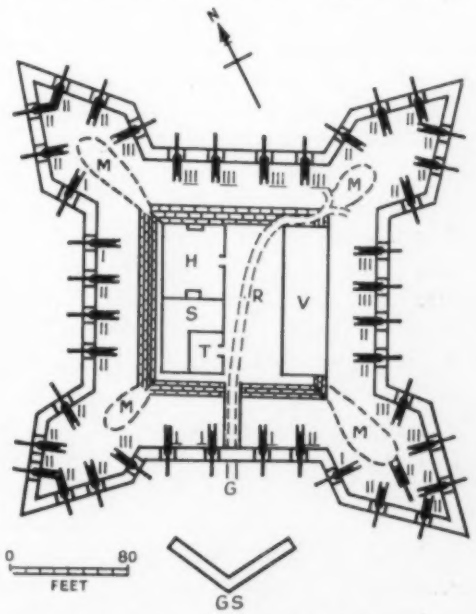
Historical Background

Aboriginal man reached the bleak shores of Hudson Bay perhaps a thousand years ago—the Eskimos from the north and west, the Indians from the southwest. Strangers in build, speech, customs and manners, they feared each other, and the Eskimos, generally worsted in encounter, retreated to the safety of their northern fastnesses. The Churchill River was a highway for the Chipewyan people to the Bay, and the Eskimos therefore recognized it as their southern boundary.

Henry Hudson discovered the Bay in 1610, paying the supreme sacrifice for the accomplishment which has perpetuated his name. Jens Munck discovered the mouth of the Churchill River just nine years later (1619). He laid up his two little vessels in Sloop Cove and with his 64 men prepared for winter. By spring death from scurvy had claimed all but Munck and two of his men. When navigation opened in June, the three forlorn survivors launched the smaller vessel, the sloop *Lamprey*, and reached Norway in September.

In 1686 John Abraham explored the river for the Hudson's Bay Company, naming it after John Churchill, later the Duke of Marlborough, who had been elected Governor of the Company in 1685.

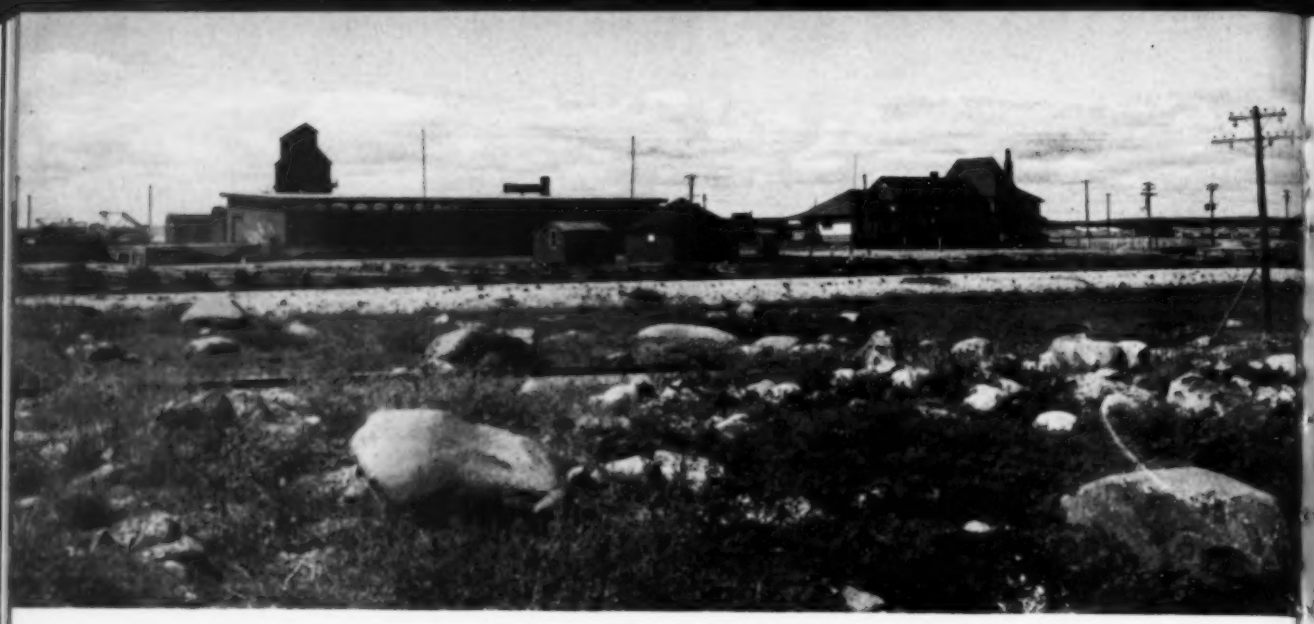
In 1689 a party including the explorer Henry Kelsey built the first Fort Churchill, which was soon after destroyed by fire. In 1717 James Knight, the first Governor-in-Chief on the Bay, sailed north from Hayes River and built a new fort on the original location on the west bank of the river and some 4½ miles from its mouth. The site is on a bench safely above high tide, and



SKETCH PLAN—FORT PRINCE OF WALES

LEGEND

G - Gate GS - Gate Shield H - Council Hall 40 x 30 ft.
T - Trade Room S - Stores R - Road
V - Probably Stores and Servants Quarters
M - Location Powder Magazines
Guns - 6 pounders I, 10 lbs. II, 24 lbs. III, Mounted I, III.



Churchill railway station and round house.

protected somewhat on the west and north by a quartzite ridge rising from 25 to 100 feet above mean tide level. To the south west is flat tundra. At low tide boulder dotted mud flats stretch out half a mile, so that boats can reach the landing only at high tide. The bench is covered with serviceable garden soil, which is generally lacking elsewhere. Only a few tiny willows and a few juniper bushes suggest trees, but false heather, mosses, lichens and many varieties of flowers decorate the blue rock surfaces during the short summer. Mosquitoes and black flies are legion. Here the fur traders exchanged knives, traps, guns, ammunition and other white man's goods and trinkets for valuable arctic fox and other furs, brought in by Eskimos from the north and Indians from the south and west.

This isolated northern post became a rendezvous for scientific and exploring expeditions. Here in 1768 William Wales and Joseph Dymond of the Royal Geographical Society observed the transit of Venus across the sun. James Knight and John Scroggs started out from here in 1719 and 1722 on explorations for the Hudson's Bay Company. In 1741 Christopher Middleton with H.M.S. *Furnace* and *Discovery* wintered at Churchill and inscribed an indelible record on the quartzite at Sloop Cove, before seeking a passage to the western ocean. Dr. John Rae left Churchill on July 5th, 1846, sailed to Repulse Bay and returned to Churchill October 31st. From Churchill, Samuel Hearne started on his three overland trips, on the last of which he discovered the Coppermine River in 1771.

But Churchill did not stand still! The threat of French domination of the Bay induced the Hudson's Bay Company to build the greatest fortification of its history, Fort Prince of Wales. It was located on a promontory known as Eskimo Point and commanded the harbour entrance which is only about one quarter of a mile wide. A battery of guns on the south side on Cape Merry faced the fort. Designed by British military engineers, the great structure is 310 feet east and west by 317 feet north and south with masonry walls nearly 17 feet high. Great angular bastions guard each corner and the grand entrance is protected by a V-shaped apron of masonry. The walls, about 5 feet thick at the top, are faced with square blocks of quartzite enclosing lime and rubble. Forty embrazures were occupied by guns varying from six pounders on the landward side to ten and twenty pounders on the harbour and seaward sides. Inside the walls, protected by 40 feet of masonry and earthworks, were the powder magazines, store houses and spacious two storey buildings for the company staff. The great hall was some

*See North on the Hudson Bay Railway, Lyn Harrington, *Canadian Geographical Journal*, August 1947.

**The Development of the Hudson Bay Project by D. W. McLachlan. *The Engineering Journal*, Vol. XVI, No. 4, 1933, pp. 155-166.

30 by 45 feet with a fireplace at each end. Numerous windows lighted the rooms, the courtyard was paved with beach stone, and cut limestone formed an approach to the manager's door.

Men and horses laboured on the great fortification from 1733 to 1771, the very year that Hearne discovered the Coppermine River. Following his daring explorations, Hearne succeeded his infamous and bigamist father-in-law, Norton, in command of the fort. Sad days followed. The French allied themselves with the Americans in the Revolutionary war, and in 1782 La Pérouse with three ships besieged the fort, landed a strong force and demanded its surrender. With fewer men than guns Hearne had no choice but to surrender. La Pérouse sacked the post, spiked and dismounted the guns and burned the buildings. Except for the work of the elements, in part repaired by the Parks Board of Canada, the Fort stands today much as La Pérouse left it.

In 1784 a Hudson's Bay trading post was re-established by Hearne on the original site up the river and was occupied continuously until the present store was built on the new townsite on the completion of the Hudson Bay Railway* in 1929. Near the old post stood the Anglican Mission and it was at this dual establishment that nineteenth century travellers, scientists and explorers were entertained.

Here came Dr. Robert Bell of the Geological Survey of Canada in 1879, making a first report on the geology of the region. He travelled down Churchill River. Here in 1893 and 1894, Dr. J. B. Tyrrell, dean of Canadian geologists, ended his canoe trips south from Chesterfield Inlet, which he had reached by canoe and portage from Lake Athabaska. He and his weary men found Churchill a haven of refuge before setting out for civilization by snowshoe and dog team. Tyrrell's reports are epics of exploration as well as the fullest reports on the geology of the region to date.

Modern Times

The pattern of life on Hudson Bay changed scarcely at all during the first two decades of the twentieth century. From 1913 to 1917, D. W. McLachlan** of the Department of Railways and Canals of Canada worked on harbour installations at Port Nelson, preparing it as the terminus of the Hudson Bay Railway which was being built from The Pas, Manitoba. The war of 1914-18 and the difficulties of the task stopped operations and in 1924 a great storm wrecked much of the plant at Port Nelson. In 1926 the Dominion Government asked Mr. Frederick (later Sir Frederick) Palmer to report on the relative merits of Port Nelson and Churchill as a terminus of the railway. Basing his opinion on investigations carried out by McLachlan, Palmer recom-

Settlement at Cockles Point.

The site of the former Hudson's Bay Company post and the Anglican Mission.

mended Churchill and, starting in August, 1927, work was carried on under great difficulties until railhead reached Churchill and regular train service was established by September 14, 1929. Hudson Bay at last was a link in a modern trade route between western Canada and Europe.*

In May 1930, a contract was let for a 2,500,000-bushel elevator. This, with four Dominion Howe dumpers, was designed by C. D. Howe & Co. of Port Arthur, and was completed on September 15th, 1931. By September 20th the *Pennyworth* and *Farnworth* were loaded with grain and sailed in the vanguard of freighters from Hudson Bay bound for Europe. By the close of the season of 1932, the port with all its equipment and unique water supply was practically complete. The 1,855 foot length of deep water dock accommodates four ships and the harbour has space for three at anchor.

The water supply consists of a reservoir excavated in the earth with a capacity of about 17,000,000 gallons. From a pumping and heating station and reservoir, water is pumped 3½ miles to the dock. A ten inch pipe carries the water to the townsite tank and from there an eight inch pipe continues to the station and dock. The pipe is carried on piles above the frozen ground and is covered with moss to a depth of 4 feet, topped with corrugated iron. The town draws its water from this water supply in the summer, but in the winter depends upon melted snow and ice. There is no general sewage system.

From 1931 until the outbreak of the second world war, Churchill grew slowly. The Hudson's Bay Company abandoned its historic site on the west side of the river, exchanging protection from the west and north winds, garden site, cemeteries and historic connection, for proximity to railway station and dock. The Anglican Mission followed the example of the Hudson's Bay Company. Varying amounts of grain were shipped to Europe, but return cargoes were light. Improved weather and ice observation were established on Hudson Strait and navigation has proved to be fairly safe for a short season. In 1948 thirty-five ships called at Churchill and the elevator delivered 5,325,884 bushels of grain.

During World War II Churchill became the centre of defence for northern Canada. Three and one half miles south east of the town, a gravel ridge provided the foundation for an excellent air field, and Landing Lake (Farnsworth Lake), two and a half miles farther south, was used for hydroplanes. The military camp and hospital were

*See Port Churchill, Denzil G. Ridout, *Candian Geographical Journal*, August 1931.

The protected pipeline that carries Churchill's water supply. In the background are the grain elevator, radio station and R.C.M.P. barracks.

established just to the north of the aerodrome. An excellent meteorological station was established in 1941 at Churchili town.

After the war Churchill became the centre for Canada's northern airways, meteorological services, and arctic investigations. The Muskox expedition started from Churchill in 1946, a modern version of Samuel Hearne's expedition of 1771.

Horticulture

Good gardens were cultivated at the old Hudson's Bay site on the west side of the river and cattle and horses were formerly kept there.

Giving evidence before a select committee of the British House of Commons in 1749, Mr. Joseph Robson*, a servant of the Hudson's Bay Company, of wide experience, stated that he "had seen oxen and horses belonging to the Company at Fort Prince of Wales, which were brought from England and fed with hay and corn, the hay being got there and made into stacks".

Below:—Hudson's Bay Company store.

*The Unexploited West. Railway Lands Branch, Dept. of the Interior, Ottawa, 1914, pp. 30-37.

Left:—Post Office and school house.

Canadian Army photograph

Dogs work in winter. This team is taking milk supplies from railhead at Churchill to the Army canteen.

He continued: "I was no farther up Churchill River than eight or nine miles, but can say that the soil is very good, and that there are gooseberries and black and red currants near the sea upon points that appear almost barren . . . The marshes and low grounds are full of good grass, and there is a patch of ground near the Fort on Eskimo Point which though exposed to the north and northeast winds, produces good radishes, coleworts, turnips, small carrots and lettuces, and other salading; blackberries also grow upon the heath . . . Cattle here would live and do well, if the same care were taken of them as is generally taken in England. The horses I found among them had been kept several years, and were constantly employed in drawing stones and other materials for the use of the Fort".

Dr. Robert Bell (Rept. of Progress, Geol. Surv. Can., 1878-79, Pt. C, p. 21) reports on Churchill as he saw it in 1879, in part as follows:—"I saw very good potatoes and turnips growing in the garden at Fort Churchill. Previous to the advent of Mr. and Mrs. Spencer, the cultivation of potatoes had not been attempted . . . in spite of predictions of certain failure, ground was prepared, seed planted, and a good crop harvested. The experiment has been repeated successfully for seven consecutive years . . ."

"Hay can be cut in abundance in the neighbourhood of Fort Churchill, and cattle thrive well . . . Now, the small herd which is kept at the place is recruited by raising the animals calved at the Fort itself.—The butter made by Mrs. Spencer could hardly be excelled for quality and fineness of flavour in any country." Mr. J. R. Spencer was the Post Manager for the Hudson's Bay Company.

The successes attained in gardening on the west side of the harbour stand in strong contrast to the slow growth in the tiny box gardens on the new townsite, where only modified beach sand is present. A sample of soil taken by the writer from the old garden to which Bell refers, has proved to be very fertile and it seems likely that a part of the vegetables used at Churchill could be raised successfully on the flats along the west side of the river.

Climate

The climate of Churchill is essentially that of the Eastern Arctic, where the average mean temperature of the warmest month is not above 50°F. The winters are long and cold and the summers are short and cool.

The following summary was supplied by the Air Services Meteorological Division, Department of Transport, Toronto.

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean daily maximum F.	-11.3	-8.0	4.1	23.7	37.7	51.7	64.5	62.1	49.0	33.5	13.3	-3.1
Mean daily minimum	-26.7	-25.4	-16.2	4.2	21.5	33.6	42.8	42.6	34.5	19.9	-1.6	-18.9
Mean	-19.0	-16.7	-6.1	14.0	29.6	42.6	53.7	52.4	41.8	26.7	5.9	-11.0
Highest on record	39	31	41	62	87	88	96	87	84	62	45	34
Lowest on record	-57	-52	-52	-26	-14	13	22	25	15	-17	-53	-47
Rain	0.00	0.00	0.02	0.12	0.75	1.71	2.19	2.69	2.16	0.63	0.00	0.00
Snow	4.8	6.1	8.5	7.7	1.8	1.4		Trace	1.7	8.0	10.3	6.6
Total precipitation	0.48	0.61	0.87	0.89	0.93	1.85	2.19	2.69	2.33	1.43	1.03	0.66

The ice went out of Churchill harbour about midnight, June 20, 1947. The average date is about June 15th, and Tyrrell gives the average of open water as about five months. Deep water ships are expected early in August and navigation lasts into October.* The season is limited in reality by ice conditions in Hudson Strait. Hudson Bay appears to freeze over completely in the winter except for a belt outside the shore ice. This great frozen sea in the middle of Canada has a marked effect upon the climate of central and eastern North America.

Land and Sea Level

The relation of land and sea level has an important bearing on the future of Churchill. Robert Bell concluded, from observations made in 1879, that "the relative level of the sea and land in this vicinity is changing at the rate of about seven feet in a century". J. B. Tyrrell after visiting Churchill in 1893 and 1894 weighed available evidence and concluded in reference to Sloop Cove, "If the deepest part of the mouth of the Cove can now be seen and if the ships required six feet of water to float them into it, there would here be evidence of the rise of the land to the extent of two feet in the last century and a half, but as neither of these points is certain, the evidence in favour of this rise is too indefinite to be considered at present."

Fifty-three years after Tyrrell made his observations, the writer studied the same evidence and came to the definite conclusion that Tyrrell was correct in his judgment, but that if any subsequent change has occurred it is a negative rather than a positive movement of the land, howbeit of small amount.

The evidence may be summarized as follows:—A small rock-bound cove on the west side of the river, some 2½ miles north of the old site of Fort Churchill, was probably used by Jens Munck in the winter of 1619-20 as a natural harbour for his small ships, which drew when unloaded about 6 feet of water. Later expeditions used this shelter and the *Furnace* and *Discovery* left their record chiselled on the quartzite rock and dated 1741. The last line of this inscription was about 3 feet 3 inches above the spring tide of November 2nd, 1893, as determined by Tyrrell, and 2 feet above the high tide level of July 5th, 1947, as observed by the writer. This inscription shows no signs of ever having been covered by sea water and it is unlikely that inscriptions would have been cut below high tide mark. A recent bar has formed across the entrance to the cove

*In 1948 the first ships arrived at Churchill on August 8th and the last one sailed on October 8th.

During the summer season sled dogs are kept chained up.

to the depth of about 18 inches and mud has washed into the basin. With the spring tide of July 5th, 1947, there were about 5½ feet of water over the bar and more than 6 feet of water in the basin. According to report, the highest spring tides are one foot or more above that observed. Iron rings set in the rocks for mooring ships vary in height from 6 to 14 feet above high tide, but one ring was fastened into rock at a location today washed by tidal water and here all has rusted away but the base and the lead which fastened it. This ring was obviously for heaving the ships ahead.

A map of the harbour was made by Joseph Robson, the engineer supervising the building of Fort Prince of Wales from 1733 to 1747. This shows the shore line and tidal range without noticeable variation from present conditions. The old beach gravels with their contained Saxicavas and Pectens, some of which maintain colour bands, represent a definite post glacial rise of the land in reference to the sea, of about 350 feet (cf. Bell) but there appears to be no reliable evidence of change in historic time. An isostatic negative anomaly equivalent to some 1,500 feet of rock, reported by A. H. Miller of the Dominion Observatory, would suggest a possibility of a further rise of the coast. On the other hand friction, the strength of the rock crust of the region and the burden of water in Hudson Bay, offset to some extent the probability of complete readjustment.

Military exercises are carried on from the base at Churchill. Camping under canvas with the temperature around 30° F. below zero. Canadian Army photograph

Mooring ring set in the rock at Sloop Cove. The grain elevator and dock can be seen on the eastern shore.

The Future of Churchill

The future of Churchill appears to be linked mainly with air transportation. It is a natural air centre for northern Canada, and the light snowfall of the region enhances its value. The stable nature of the frozen roadbed makes rail upkeep relatively cheap. For the short shipping season, excellent harbour facilities provide rapid loading for the supply of grain from the current crop year, and an appreciable saving on freight rates to Europe for northern Saskatchewan and Manitoba. Return cargoes have so far been light. With the exception of the possibility of small supplies of local garden produce, all food, fuel and other necessities must come from outside. The Pas will be able to supply milk and dairy products, but its main function will be that of a junction connecting with the main lines of transportation at Hudson Bay Junction. The fur trade continues about as in the past, in contrast with the dominating increase in other commerce. Tourist activities will increase as accommodation advances. The time may come when the peninsula on the east side of Churchill River, including the civil and military establishments, should be set apart as a wild life refuge and park in order to protect some of the rare species of birds nesting there. This would probably increase the attraction to tourists.

It seems hardly likely that an amelioration of climate at Churchill will follow settlement as has occurred where there is general cultivation. The rock, gravel ridges and muskeg of Churchill do not provide a basis for agriculture beyond the garden stage. It does seem likely however that control of insects by aerial spraying of D.D.T., as was tried out in 1947 by the Air Force, may greatly lessen the mosquito and blackfly population. The writer found sticklebacks in the lakes and pools and these little fish lessen the plague of mosquitoes.

For more than two centuries Churchill has been an isolated centre of trade and scientific investigation. Its future points to advancement along the same roads, but in a manner in keeping with the times.

Notes on the natural history of Churchill by Dr. Williams will appear in a later issue.

* * *

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EDITOR'S NOTE-BOOK

F. J. Alcock was born in Griersville, Ontario. Educated in Ontario, he graduated from the University of Toronto with honours in geology and mineralogy. His post-graduate studies were conducted at Yale University, where he received his Ph.D., and at the University of Wisconsin. From 1915 to 1917 Dr. Alcock was a member of the staff of the Geological Survey of Canada where his principal activities were in connection with the Precambrian fields of the West, the Appalachian and Acadian region of the East, and the zinc and lead deposits of the Dominion. Since 1947 Dr. Alcock has been Curator of the National Museum of Canada.

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H. W. Gendreau was born at Abbotsford, Quebec, at the foot of one of his "hills of home" about which he writes in this issue. He attended the Feller Institute at Grande Ligne, but claims that most of his education has been through the more interesting medium of travel. He has lived in countries in the Far East as well as the west. Mr. Gendreau has published several books on travel in the Province of Quebec, and his short stories and articles have appeared in numerous periodicals.

* * *

E. O. Hoppé has already brought to our readers articles which share his interest in many lands and many peoples. Now living in England, Mr. Hoppé was born in Germany in 1878, and educated in Paris and Vienna, His vocation of photography and writing has taken him to many corners of the world. His ambition: to gain recognition for photography as an art medium.

* * *

M. Y. Williams is a native of Bloomfield, Ontario. After graduating from Queen's University he studied at Yale University for his Ph.D. Dr. Williams taught for a few years, then joined the Geological Survey of Canada, on whose staff he served for some twelve years. In 1921 he joined the staff of the University of British Columbia where he is now head of the Department of Geology and Geography. As a consulting geologist Dr. Williams specialized in petroleum and natural gas and was concerned in many geological projects including oil field development, the Pacific Great Eastern Survey, survey of Hong Kong, and the Alaska Road planning project. Dr. Williams is the author of numerous bulletins and articles on geological subjects in learned journals.

* * *

AMONGST THE NEW BOOKS

Our Evolving Civilization

by *Griffith Taylor*

(University of Toronto Press—Saunders, $5.00)

This stimulating work in four Parts has added to and still further enhances the already impressive list of contributions from one of the world's outstanding geographers. The scope of this latest book from Dr. Taylor's prolific—and fast moving—pen, is reflected in the outline of contents which includes the following Parts:—World Plan: Climatic Control: Racial Differentiation; Environment, Culture and Nation; Environment, Village and City; and Geopolitics and Geopacifics. The four Parts include fourteen chapters, each of which is developed under numerous sub-headings. Such a plan will commend itself to many readers.

In *Our Evolving Civilization*, Dr. Taylor brings to bear on his subject a deep insight into basic factors which have governed the evolution of our present-day, so-called, 'civilization'. Such insight reflects a background of world-wide travel, and exceptional opportunities for world-wide study by a keen and analytical mind.

We have referred to Dr. Taylor's book as stimulating, and it is to be regretted that limited space available does not permit of adequate comment on certain conclusions reached by the author. Apart from rendering available for reference an imposing compilation of statistical data, there are one hundred Figures which include sections, block diagrams, stage diagrams, dynographs and maps.

Part IV (Geopolitics and Geopacifics) deals, *inter alia*, with the influence of environment as a factor in war and geographical factors in the peace problems of Europe. This section of Dr. Taylor's book should prove of unusual interest to military men. S.C.E.

* * *

Days Without Time

by Edwin Way Teale

(Dodd Mead & Company, Toronto, $6.50)

The contents of this book are as alluring as its title. When time jostles and city walls and pavements seem to press, Mr. Teale offers a way out He writes of the out-of-doors, of days of sun time and wind time, spaced only by the "swing of the shadows", and of the eternally recurring events of nature. Mr. Teale's easy-flowing, lilting prose induces relaxation, and his enthusiasm for natural history is infectious. He finds

a world in a clump of grass and delight in an insect egg. You may never have given a thought as to how a skunk cabbage is able to penetrate frozen ground and snow or how air-breathing larvae mature under water. Nor may you have cared. But Mr. Teale unfolds his tales in a fascinating way which stirs the imagination, and his beautiful photographs, to which 80 pages are devoted, furnish material on which to dwell. As the author points out, in this modern age "while far-away wonders have become commonplace, commonplace wonders have remained unperceived". In bringing us back to the wonders in the world at our feet, Mr. Teale performs a great service for us. One feels that, next time, one will look at a tide-washed beach or a garden toad with eyes that have been opened to see.

M.B

* * *

Physical Geology

by Chester R. Longwell, Adolph Knopf and Richard Foster Flint

(John Wiley and Sons, Inc., New York, $5.00, third edition)

This volume, the two previous editions of which have been used by numerous colleges and universities in the United States and Canada, is a new and revised book which should prove to be still more popular than its excellent predecessors. Some of the chapters have been entirely re-written and an important new one has been added,—"The Method and Scope of Geologic Study"—which discusses the scientific method in geology, the continents, movements of the crust, the contest between internal and external forces, and the time element in geology. The volume discusses most recent data on such subjects as glaciation, igneous geology, metamorphism, seismology, etc. A great many of the illustrations used throughout are new. They include a large number of block diagrams specially prepared to explain the origin of structural features and land forms Three appendices, A, B, and C on Minerals, Rocks, and Topographic Maps respectively, will prove extremely useful to those beginning their studies in geology. Of interest to teachers is a set of 250 colour slides which can be obtained to supplement the text. The price of the set is $85.00.

F.J.A.

* * *

Submarine Geology

by Francis P. Shepard

(Harper and Brothers, New York, $6.00)

Over three-fourths of the earth's surface lies beneath oceanic waters and of this vast area investigations have touched only a minute portion. Nevertheless, as a result of the development of echo sounding devices begun a few years after the close of the first World War and of recent researches, a great deal of new information has been accumulated which Dr. Shepard here presents in a most interesting form.

The volume is made up of twelve chapters which discuss this phase of geological science: introduction and history; methods of exploring the ocean floor; waves and currents; classification of seacoasts and shorelines; beaches and sand shifting along the shores; the topography and sediments, origin and history of the continental shelves (2); the continental slopes; submarine canyons; coral reefs; the floor of the deep oceans; and summary and economic applications.

One of the most interesting sections is the discussion of the mode of origin of submarine canyons, a problem that has long been a subject of disagreement among geologists. Every one admits that in form and pattern these canyons resemble valley systems cut by streams on land. Many geologists, however, dismiss this possible mode of origin, because of the fact that the canyons extend for thoosands of feet below sea level, thus demanding, on this theory, a rise of the continental borders and a subsequent depression to an amount of some ten thousand feet, both movements within comparatively recent times. Dr. Shepard, however, does not so dismiss this possibility; in fact he favours the idea of subaerial origin. Such tremendous changes of level could have resulted, he believes, if the Pleistocene ice-sheets at the time of their maximum development were very much thicker than has hitherto been assumed to be the case. Sea level would thus have been lowered a correspondingly greater amount: in addition the weight of the ice would have depressed the ice-covered parts of the continents and as a result caused the bowing up of the continental margins. This is the first support that the reviewer has seen to the strong case for the subaerial origin of the canyons presented by Veatch and Smith.

The volume is a very readable one. It is well illustrated by photographs and charts. Aside from its general interest to all geologists it will be of value to engineers interested in such problems as the possibility of obtaining oil from the rocks of the continental shelf.

Dr. Shepard is Professor of Submarine Geology, Scripp's Institution of Oceanography, University of California.

F.J.A.

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